Archaeological human remains from the River Thames and its London deposits

Nichola Alice Arthur

A thesis submitted for the degree of PhD

University College London

Declaration

I, Nichola Arthur confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Abstract

Watery places, such as rivers, lakes, and bogs, are widely considered to have been foci for ritualised deposition during the prehistoric and early historical periods in northwest Europe. Hundreds of human remains, mostly isolated crania, have been recovered from the London reaches of the River Thames over the last two centuries, predominantly through historical dredging activities. The origin of these remains has long been debated: one line of thought arguing that the majority reflect later prehistoric ritual deposition practices, and another that they are the result of fluvial processes acting through time. While mindful of previous scholarship, this thesis aims to move beyond the debates as previously configured. Emphasis is placed on the physical remains themselves, and multiple lines of new radiocarbon, taphonomic, osteological, and stable isotopic carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulphur ($\delta^{34}S$) data have been generated. This large dataset is utilised to provide a comprehensive examination of the assemblage and its deposition. The new radiocarbon dates confirm previous observations of a bias towards individuals of Late Bronze and Iron Age dates. A bias towards adult males and a high prevalence of violence-related trauma suggest a possible relationship between martial activities and deposition in the Iron Age, and potentially also the Late Bronze Age. Highly depleted $\delta^{34}S$ values were identified for the prehistoric period individuals, which are among the lowest found in any Holocene European context to-date. These low values likely indicate the utilisation of floodplain resources, and that these individuals may have lived locally to the river floodplain. Overall, the findings of this thesis do suggest that the deposition of many of the human remains in the river may have occurred in ritual contexts in certain time periods, as opposed to being purely the result of fluvial processes acting through time.

Impact statement

London and the River Thames are areas of great archaeological significance, both within Britain and internationally. This examination of the human remains from the river provides new evidence regarding the possible funerary practices and lifeways (e.g., exposure to violence, diet) of the people living alongside the river through time: from the Neolithic to the Post-Medieval period. This information is particularly significant for the prehistoric period, for which relatively little is known about human activities in the London area (e.g., Sidell, 2001). The conclusions drawn from this study also contribute to broader understandings of the significance of watery environments to past peoples: the human remains from the River Thames represent the largest assemblage of human remains from a watery context in Britain, and are often invoked as unequivocal evidence for prehistoric funerary practices involving water (e.g., Bell et al., 2000; Evans, 2013).

This thesis integrates human remains which have been recovered from the river foreshore in recent years: some by mudlarks, some by members of the public, and some through archaeological foreshore surveys and monitoring activities. The valuable contribution that these remains make to enhancing understandings of deposition in this thesis emphasises the importance of Thames foreshore archaeology. In particular, this work underscores the importance of the ongoing recording and monitoring activities, such as those organised through the Thames Discovery Programme.

Acknowledgements

Firstly, I extend a huge thanks to my primary supervisor Dr Heather Bonney, and to my supervisory team Dr Jane Sidell, Dr Louise Martin, and Dr Rhiannon Stevens. Their support and encouragement throughout this period have been invaluable. A special thanks also to Dr Rebecca Redfern for her support during data collection and for lending her expertise throughout.

My thanks to my excellent family and friends for their unwavering support: George, of course (you couldn't carry it for me, but you did carry me!), but also my parents, who have been there for me throughout the pursuit of this work and everything else before it, and Susie and Ben, whose kindness and generosity have been so important over this last year. Thanks especially to Steph, Jessica, Joy, and Alex, to my DTP friends for their solidarity and good humour, and to those at the Museum.

I'd also like to extend my gratitude to everyone I've met along the way who has assisted me in this research, through sharing their knowledge or helping me to develop new skills, including Thomas Baird, Hester Hanegraef, Hazel Reade, Jennifer Tripp, Eliott Wragg, Jelena Bekvalac, Stuart Wyatt, Neil Wilkin, Chelsea McKibbin, and Laura Hampden and the rest of the Greater London Historic Environment Record team.

Finally, thanks are due to the Natural Environment Research Council for enabling this PhD research through the London DTP, and also to the Charles Wolfson Charitable Trust for funding the radiocarbon dating.

Table of Contents

List of Figures

List of Tables

Appendix Tables

Chapter 1 Introduction to the research

1.1 Overview of the research

Hundreds of human remains, mostly crania, have been recovered from the London reaches of the River Thames and its associated deposits over the last two centuries. These remains were mainly recovered through late 19th and early 20th century dredging activities, but a number have also been recovered through construction works, archaeological excavation, and as chance finds on the river foreshore. So prolific in number were the remains encountered in construction works near Battersea Bridge in the middle of the 1800s, that it was described as "our Celtic Golgotha" by one contemporary observer (Cuming, 1857). Previous dating work on a limited number of these remains has identified individuals ranging in date from the Early Neolithic to Post-Medieval periods, with the majority dating to the Bronze and Iron Ages.

Naturally, since Victorian times, these remains have attracted scholarly attention, and this has largely focused on debating their depositional origins. One line of thought has proposed that the remains are related to wider prehistoric practices of ritual deposition in watery places (Bradley and Gordon, 1988; Schulting and Bradley, 2013). Underpinning this anthropogenic interpretation is the observation of a temporal and geographic relationship between the crania and the vast quantities of prehistoric metalwork recovered from the River Thames, with both being recovered from the same stretches of the river and presenting a bias towards Late Bronze and Iron Age dates. Emphasis has also been placed on the over-representation of crania in relation to ideas of ritual deposition.

An opposing line of thought has proposed that the remains represent fluvial accumulations, which have arisen through the action of various processes through time, including the erosion of riverside burials and the inclusion of bodies of drowning victims (Knüsel and Carr, 1995). The lines of evidence drawn on to support this interpretation include the wide temporal span of the radiocarbon dates produced for the remains, the over-representation of crania, patterns of taphonomic damage, and the demographic profile of the remains.

While keeping previous scholarship and debates in mind, this thesis will give another perspective, utilising multiple lines of evidence: new radiocarbon,

taphonomic, osteological, and isotopic data, to provide a comprehensive examination of the human remains from the River Thames and their deposition. Emphasis is placed on focused study of the physical remains themselves, an approach utilised to good effect in the study of human remains from watery places (e.g., Fredengren, 2018; Gummesson et al., 2018; Holst et al., 2018).

The deposition of the Maynard Reservoir assemblage is additionally examined to complement the discussion of the River Thames assemblage. The Maynard Reservoir assemblage is a smaller, but better contextualised, assemblage of human remains, recovered during 19th century construction works along the lower River Lea, a Thames tributary. Previous radiocarbon dating has identified that some of the remains are Late Bronze Age in date (Schulting and Bradley, 2013).

This is a particularly timely moment to re-visit the River Thames assemblage, and the question of deposition. An ever-growing number of human remains are being encountered on the river foreshore at present, some identified by mudlarks as this activity increases in popularity, and others encountered during archaeological excavations related to construction projects, such as the Thames Tideway Tunnel. Many of these remains are incorporated in this thesis, and provide an important comparison sample for interpretations drawn from dredged remains, which are more numerous but have less secure contextual information. Additionally, radiocarbon dates have been produced for many of these remains by the Metropolitan City and Police forces, independently of specific academic projects. The construction-related archaeological activities taking place in the vicinity of the river foreshore are also revealing new evidence for human activity along the River Thames (e.g., the Thames Tideway Tunnel excavations at Barn Elms). This evidence has been identified as somewhat lacking in the past, particularly for the prehistoric period (e.g., Brown and Cotton, 2000; Sidell, 2001), and this additional archaeological context may allow for more secure interpretations of the deposition of some of the Thames human remains. Finally, this thesis utilises relatively new analytical techniques (i.e., sulphur isotope analysis, ancient DNA data), which are capable of yielding particularly novel perspectives on the human remains, and their deposition.

The specific aims of this thesis are outlined below.

1.2 Aims of the research

There are three broad aims of the research:

1) To gather and analyse a significant new body of radiocarbon, taphonomic, osteological, and isotopic data on human remains recovered from the London reaches of the River Thames.
2) To use this new dataset to examine aspects of the deposition of human remains recovered from the London reaches of the River Thames.
3) To achieve the above aims for an additional focal sample from the Lower Thames Valley: the Maynard Reservoir assemblage.

A series of specific aims have been developed to achieve the above. The ordering outlined here corresponds to the order in which these are addressed in this thesis:

A. To further understanding of the temporal patterning within the assemblages

An enhanced understanding of the underlying temporal patterns within the assemblages is fundamental for developing interpretations of deposition. This will be achieved through the production of new radiocarbon dates for the human remains, and the amalgamation of these with all dates generated externally to the current project in order to create a single, large, temporal dataset. Aim A is addressed in Chapter 6.

B. To examine the post-death taphonomic histories of the assemblages

Examining the taphonomic histories of the River Thames and Maynard Reservoir assemblages will provide insight into the processes involved in their formation. To address this aim, various lines of taphonomic data will be generated and analysed, with a specific focus on features of the general depositional environment, and evidence for the fluvial transport of the remains. Aim B is addressed in Chapter 6.

C. To examine the demographic (i.e., age-at-death and sex) profile of the assemblages

The demographic profile of a skeletal assemblage can provide clues as to the processes which were involved in its formation. A demographic profile which deviates from that which would be expected under conditions of normal, attritional, mortality has been observed in some of the previous studies of the River Thames assemblage (Bradley and Gordon, 1988; Knüsel and Carr, 1995), and has been variously interpreted. This thesis re-examines the demographic profile of the assemblage, benefitting from new radiocarbon data, the integration of remains recently recovered from the river foreshore, and the integration of new ancient DNA (aDNA) data generated externally to this thesis (Booth, 2019; Green et al., 2019) which provides genetic sex estimations for many of the River Thames individuals. Aim C is addressed in Chapter 7.

D. To examine the patterns and prevalence of violence-related trauma within the assemblages

Human remains recovered from watery environments often show evidence of violence, experienced both during life and at the point of death, which can hint at the circumstances surrounding their deposition. A previous examination of a subsample of the River Thames assemblage found some evidence of violence, but hypothesised that the prevalence was consistent with other contemporary burial groupings (Schulting and Bradley, 2013). This study provides a full re-examination of the osteological evidence for violence in the assemblages and, again, benefits from the provision of new radiocarbon dates. Aim D is addressed in Chapter 7.

E. To investigate the dietary compositions of individuals within the assemblages, through the application of carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulphur ($\delta^{34}S$) stable isotope analysis

Dietary composition, as evidenced by stable isotope analysis, can provide essential information about the lifeways and social identities of individuals and groups. This thesis represents the first time such data has been obtained for the individuals within the River Thames and Maynard Reservoir assemblages, with the specific aim of examining dietary composition. In addition to providing dietary information, sulphur isotope analysis is a relatively new technique, and has the potential to yield information about geographic mobility. Aim E is addressed in Chapter 8.

1.3 Terminology and chronology

1.3.1 Deposition

The term deposition has been applied in a variety of ways in archaeological literature. For example, the concept of structured deposition emerged in the 1980s (e.g., Richards and Thomas, 1984) and has been applied widely, and variably, since (Brudenell and Cooper, 2008; Joyce and Pollard, 2010). Structured deposition can be broadly defined as “past action which engaged in a meaningful way with materials leaving what we see today as traces of structure in archaeological deposits” (Joyce and Pollard, 2010:9).

In this thesis, the term deposition is used in a more general sense, to refer to aspects of the human practices, whether intentional or unintentional, and also natural processes which have been responsible for the ultimate inclusion of human remains in the river deposits. This is broadly in-keeping with calls for contemporary studies of deposition to set aside “distinctions between intentional and unintentional, deliberate and accidental, symbolic and quotidian action, and understand deposition as always the product of practices by differentially knowledgeable actors whose work assembling sediments and worked and unworked things created the contextually associated assemblages we interpret” (Joyce and Pollard, 2010:9).

1.3.2 Ritual

There is, and has historically been, little consensus on the definition of ritual in archaeological literature (e.g., Levy, 1982; Hill, 1995; Brück, 1999). Trends in archaeological ritual theory tended to broadly follow developments in anthropology (Bradley, 2005:31). Many early definitions were influenced by a sacred:profane dualism, where ritual was only considered to be present in the former (Durkheim, 1965; Turner, 1967). However, it has been argued that this distinction is not recognised in all societies (e.g., Brück, 1999), and that ritual is not confined to the realm of the sacred (e.g., Bell, 1992). Rather than pursuing distinctions between ritual and non-ritual activities (e.g., Levy, 1982), emphasis shifted to the concept of ritualisation (e.g., Bell, 1992; Humphrey and Laidlaw, 1994). This framework understands actions as becoming ritualised through their performance, and which may therefore be present in many aspects of life (Lamdin-Whymark, 2008:21). This

thesis follows Bradley (2005:116) in understanding that ritualisation exists wherever “certain parts of life are selected and provided with an added emphasis”.

1.3.3 The River Thames

This thesis focuses on the human remains recovered from the Lower Thames, which is defined as the river’s tidal reaches: downstream of Teddington Lock, through London, and out to the Thames Estuary. The Upper and Middle Thames areas are also referred to in the text. The Upper Thames refers to the stretch of river between its source in the Cotswolds and Goring Gap, where the river cuts through the chalk escarpment of the Berkshire Downs and the Chiltern Hills. The Middle Thames is the area between Goring Gap and Teddington Lock. These definitions are those generally used to describe the topography of the River Thames (e.g., the Thames Valley Landscapes Monograph series published by Oxford Archaeology (Booth et al., 2007; Lambrick and Robinson, 2009; Hey et al., 2011; Morigi, 2011)). The term “eyot” is used throughout the text, and specifically refers to small islands within the River Thames.

1.3.4 Chronology

This work covers a wide temporal range and, as such, a general chronological framework has been adopted, as defined below. This framework is based on Historic England's Periods list (Historic England, 2015), as this is widely applied in relation to British archaeology and cultural heritage. For example, it is the chronological framework recommended by the Forum on Information Standards in Heritage (FISH). Throughout this thesis, certain chronological periods are referred to at the level of the overall period (i.e., Neolithic, Roman, Medieval, Post-Medieval). However, the Bronze Age and the Iron Age are additionally subdivided into Early, Middle, and Late phases, owing to the greater number of human remains belonging to these periods. In this thesis, the term later prehistoric/later prehistory is used to refer to the period of time between the Neolithic period and the end of the Iron Age (e.g., Bradley et al., 2016).

Neolithic:	**c. 4000-2300 BC**	
Bronze Age:	**c. 2300-800 BC**	
	Early Bronze Age:	*c. 2300-1600 BC*
	Middle Bronze Age:	*c. 1600-1200 BC*
	Late Bronze Age:	*c. 1200-800 BC*
Iron Age:	**c. 800 BC- AD 43**	
	Early Iron Age:	*c. 800-400 BC*
	Middle Iron Age:	*c. 400-100 BC*
	Late Iron Age:	*c. 100 BC- AD 43*
Roman:	**c. AD 43-410**	
Medieval:	**c. AD 410-1540**	
Post- Medieval:	**c. AD 1540-1901**	

Chapter 2 Archaeological human remains from watery contexts in Britain and northwest Europe

2.1 Introduction

Archaeological human remains have long been encountered in the rivers, lakes, bogs, and other watery places of northwest Europe. The human remains recovered from these watery contexts span a broad time period, from the Mesolithic to Post-Medieval periods. A review of published examples from Britain and Ireland revealed that while examples are known from the Neolithic, Roman, and post-Roman periods, remains of probable Bronze and Iron Age date are best represented (e.g., Healy and Housley, 1992; Brunning, 1997; Allen et al., 2000; Bell et al., 2000; Pryor, 2001; Parker Pearson and Field, 2003; Ripper et al., 2012; Evans, 2013).

The purpose of this chapter is to consider how such human remains have been interpreted in the archaeological literature, and to outline some of the various contexts in which they have been encountered. Current understandings of human remains from watery contexts are limited, and no complete review has yet been produced. Instead, the literature is dominated by isolated examples which are interpreted largely on a case-by-case basis. Single assemblages have often been subject to shifting interpretations as academic ideas change, new methodologies are applied, and sometimes when modern archaeological excavations are conducted. This discussion focuses on northwest Europe, as it is contextually the most relevant geographical area to the River Thames assemblage. Although the human remains from the River Thames have played a central part in such discussions, they are considered separately in Chapter 3.

2.2 Interpretations of human remains from watery contexts

2.2.1 Ritual deposition

The major theme in the interpretation of human remains recovered from watery places in northwest Europe, particularly those which are later prehistoric in date, has been to associate them with broader practices of ritual deposition in water. Although archaeological materials recovered from watery locations were initially interpreted in largely anecdotal terms, such as accidental loss (e.g., Rock and Barnwell, 1872 on

the Broadward hoard) or the erosion of riverside settlements (e.g., Rowlands, 1976), it is now widely accepted that watery places were important foci for ritualised deposition throughout later prehistory. A 1971 study by Torbrügge on European river finds was a seminal work in this regard (Torbrügge, 1971), and has been built on since by others (e.g., Needham and Burgess, 1980; Bradley, ((1990) 1998); Fontjin, 2020). Such practices have been identified across a broad period of time, from the Neolithic period through to the 1st Millennium AD (Bradley, 1998:5). Although the importance of watery places can be said to have been fairly constant, specific depositional practices appear to have varied considerably through time and space (Bradley, 1998; van der Sanden, 2012). For example, reviewing Late Bronze Age to Roman period deposition in the bogs of northern Europe, Giles (2020) states that it is difficult to discern any dominant patterns, and that although the idea of deposition might be shared, the specifics of how and what was offered was organised "locally".

2.2.1.1 Why water?

Various qualities of watery places have been highlighted in wider discussions of deposition practices, and the most pertinent to this study are summarised below.

Water, along with other natural places, appears to have been a domain of deities or gods in prehistoric European cosmology, making them suitable spaces for forms of offering or sacrifice. This is believed to have been a feature of European Bronze Age societies (Brück, 2011), but is particularly well documented in Late Iron Age and Roman mythology. For instance, Sulis, later paired with Minerva, presided over the sacred spring at Bath (Cunliffe, 2005:576). Place names also provide some clues as to the sacred nature of some watery environments. The Roman name for the thermal spring at Buxton, *Aquae Arnemetia*, includes the element *nemet*- derived from the Gallo-Britannic word *nemeton*, meaning a sanctuary in a woodland clearing (Cunliffe, 2005:569). This suggests that the spring may have been a religious centre long before the Roman conquest of Britain (Cunliffe, 2005:569). In Ireland, the River Shannon was associated with Sinann, a goddess (Waddell, 2014:126).

It has also been suggested that some watery depositions may have been linked with the appeasement of natural forces or gods in changing environments (e.g., Brown, 2003). As an example, processes of environmental change which occurred during the Late Bronze Age and Early Iron Age have been associated with ritual deposition in British contexts. Changes in rainfall and wet shifts likely caused increased flood

magnitude and frequency during these periods, with major floods recorded for the River Trent (Howard et al., 1999), the Rivers Severn and Stour (Brown, 1988), the Tyne (Macklin et al., 1992), and the River Thames (Lambrick and Robinson, 2009). The marine regressions and transgressions which took place would have altered low-lying riverine and fen landscapes, with previously dry land being inundated during transgressions, and new marshy areas such as alder carr landscapes being created during regressions (Lamdin-Whymark, 2008:44). It has been suggested that "the dynamic nature of the expanding mires may have triggered the selection of these landscapes for ritualised behaviour" (Van de Noort, 2004:45).

It is widely thought that certain locations within watery environments were particular focal points for deposition across much of later prehistory, and also into later periods (Bradley, 2017:172). These include crossing points such as bridges and fords (e.g., Rhodes, 1991; Lund, 2005), springs (e.g., Bradley et al., 2015), and islands and sand banks (Allen et al., 2000; Brown, 2003; Evans, 2013). Attention has additionally been focused on places of environmental fluctuation, such as tidal heads (Needham and Burgess, 1980).

Some discussions of these locations have highlighted their liminal qualities (e.g., Brown, 2003; Cunliffe, 2005:568; Brück, 2011; Raffield, 2014). Although liminality as conceived by van Gannep (1960) is a state of transition during a rite of passage, it is a concept also applied to spaces within a particular social context considered to be places of "otherness" (Shields, 1991; Brown, 2003:10). It has been speculated that these watery locations may have provided "gateways" where both physical and culturally-conceived boundaries can be crossed (Brown, 2003; Lamdin-Whymark, 2008:44; Raffield, 2014:640).

2.2.1.2 The influence of classical texts

Classical texts which describe the pre-Roman societies of Europe have exerted a degree of influence over interpretations of human remains recovered from watery environments. Certain passages in Tacitus' *Germania* (c. AD 98) are cited particularly often. One describes how "'the coward, the shirker and the disreputable body are drowned in miry swamps under a cover of wattled hurdles" (cited in Aldhouse-Green, 2001:117). Another passage which describes human sacrifice of slaves in water as part of the cult of Nerthus, a goddess of fertility, is also regularly cited (e.g., Glob, 1969).

Some passages describe how the spoils of war would be deposited as offerings to gods. In his *Annals* Tacitus described a battle between the *Hermunduri* and the *Chatti* which took place in AD 58, occasioned by a border dispute possibly involving the River Main. Tacitus described how the *Chatti* had taken a vow to devote "in the event of victory, the enemy's army to Mars and Mercury, a vow which consigns horses, men, everything indeed on the vanquished side to destruction" (cited in Grane, 2003:145). A similar practice was reported by Osorius in his *Historiae Adversum Paganos* (c. AD 418), which specifically mentions the disposal of war spoils in water by the *Cimbri*, after their defeat of a Roman army in 105 BC. Osroius states "the enemy, who had seized both camps and a huge amount of booty, destroyed all that had fallen in to their hands in an unheard-of and hitherto unknown maledictory ritual; clothing was torn apart and thrown away, gold and silver were thrown in the river, the men's armour was cut to pieces, the breastplates of the horses were sunk in the waters, the people were hanged from trees with a rope around their necks" (Grane, 2003:146).

Over-reliance on such sources has been criticised, and is currently particularly avoided in studies of the British Iron Age (Joy, 2011). For example, these classical observers may have had limited understanding of the practices they were describing (Bradley, 1998:191). However, such texts have been influential in interpretations of human remains and other materials recovered from watery places, particularly in relation to bog bodies where explanations have focused heavily on the idea of ritual sacrifice (e.g., Glob, 1969; Aldhouse-Green, 2001).

2.2.1.3 Sites and interpretations

The following section provides an overview of various sites, focused on Britain but also drawing upon examples from wider northwest Europe where appropriate, which have been interpreted, broadly, as providing evidence of ritualised depositions in water. This is not intended to be an exhaustive overview of sites, but rather to illustrate the range of sites and interpretations which have been forwarded in order to provide context for the River Thames and Maynard Reservoir assemblages.

The later prehistoric bog bodies from northwest Europe are often interpreted in terms of sacrifice, punishment and the burial of outsiders, with some authors specifically drawing on the aforementioned classical texts (e.g., Glob, 1969; Aldhouse-Green, 2001). Studies of the remains themselves have revealed various

features which have been drawn on to complement such interpretations: for example, many appear to have met with excessively violent deaths, some to have been restrained, and others to have been staked down in the water (van der Sanden, 2012). Some studies have applied similar interpretations to skeletonised remains from watery contexts. Fredengren (2018) examined biological sex, age-at-death, pathologies, and trauma patterns in Late Bronze and Early Iron Age skeletal remains from Swedish wetlands. Findings relating to a male bias, a high prevalence of antemortem and perimortem trauma, and osteological stress indicators were interpreted in relation to the deposition of the human remains as victims of sacrifice: socially excluded "others" who were selected for deposition (Fredengren, 2018). Recently, Giles (2020) has argued for less emphasis to be placed on such interpretations in relation to bog bodies, arguing that many of the deaths should remain open verdicts, and that a variety of possibilities should be considered on a case-by-case basis, including accidental death, formal burial, and suicide.

Human remains have, in many cases, been recovered from watery sites with evidence for the ritual deposition of a variety of objects, such as metalwork, on a large scale and sometimes across broad periods of time. Two of the best-characterised of these sites from Britain (in part owing to their excavation to modern standards), are described below.

The Flag Fen basin in Cambridgeshire (Pryor, 2001) has been interpreted as a major site of ritual deposition in the Late Bronze and Iron Age. Here, a substantial Late Bronze Age timber post alignment, over a kilometre in length and dated to 1300 to 900 BC, crossed a wetland area. A large artificial platform of contemporary date (the Flag Fen platform) intersected the post alignment. Distinctive assemblages were recovered in excavations both in the area of the platform, and also at the southern part of the post alignment (the Fengate Power Station site). Some 275 pieces of metalwork, mostly of Iron Age date and including weaponry and ornaments, were recovered from the vicinity of the platform. Some of these had been deliberately damaged prior to deposition. Complete ceramic vessels were also recovered here, along with the skeletal remains of dogs and the skeletal remains of at least two humans (Halstead and Cameron, 1992; Halstead et al., 2001; Pryor, 2001). The skeletal remains of at least a further seven humans (cranial and post-cranial remains) were recovered next to the post alignment at Fengate Power Station (Halstead and Cameron, 1992; Halstead et al., 2001; Pryor, 2001). Pryor

(2001:427) suggests that the timber platform may have been an “island” of diverse ritual importance, perhaps associated with rites of passage.

The site of Fiskerton on the River Witham in Lincolnshire (Parker Pearson and Field, 2003) provides a similar example of human remains encountered at a significant site involving the deposition of large quantities of metalwork and other objects in water. Here, over 150 objects of Iron Age to Roman date were recovered in association with a wooden causeway, which was in use during the Middle Iron Age (Parker Pearson and Field, 2003). The artefactual assemblage included weapons (particularly swords and spears), tools, ceramics, and personal ornaments. The well-known River Witham shield was recovered from a location nearby in 1781 (Cunliffe, 2005:567). Three fragments of human bone were recovered: a left parietal bone with a perimortem weapon injury, and two post-cranial bones. This site has been interpreted in terms of ritual deposition in water, possibly made in a context of pilgrimage after the causeway had fallen into disrepair (Parker Pearson and Field, 2003).

Many of the watery sites from which human remains have been recovered have been argued to have a direct relationship with ritual behaviours associated with violent conflict. These sites tend to also involve the deposition of large quantities of metalwork, and to include significant numbers of human remains, many of which are male, and many of which present evidence for violent trauma.

The most notable of these is perhaps the site of La Téne on the shores of Lake Neuchâtel in Switzerland. First discovered in 1857, hundreds of items including vast quantities of weaponry, tools, brooches, animal remains, and equestrian equipment were recovered from the lake bed in the 19th and 20th centuries, in the vicinity of large wooden structures (Fitzpatrick, 2018). Many artefacts were so distinctive that they gave their name to a phase of the European Iron Age, and a style of art (Bradley, 2017:12). The skeletal remains of around 50 to 100 people were also said to have been recovered, one of which was reported to have had a “noose” around their neck (Fitzpatrick, 2018). According to Alt and Jud (2007), only 16 of these remains can now be identified in museum collections. Their work on these remains identified the presence of seven males, one female and one subadult, seven of which showed evidence of violence. This included multiple perimortem sharp force injuries, which were consistent with decapitation in one individual.

The site of La Téne has been subject to shifting interpretations: from a flood site, to an armoury, to a site of votive deposition, potentially including human sacrifice (Rolle, 1970; Bradley, 1998:164; Fitzpatrick, 2018). Most recently however, it has been interpreted as the remains of a trophy which displayed the bodies and equipment of an army defeated in c. 220-200 BC (Lejars, 2013). This interpretation is largely based on the observance of multiple similarities between this site and recent excavations of dryland cult sites of similar date, such as Gournay-sur-Aronde and Ribemont-sur-Ancre in present-day France (Fitzpatrick, 2018). For example, at Ribemont-sur-Ancre, the remains of hundreds of young males, many presenting evidence of violence and decapitation, were found alongside thousands of weapons. Lejars (2013) argues that the wooden structures at La Téne may represent a structure upon which the objects, human remains, and animal remains (which included two perforated horse crania) were displayed, before eventually finding their way into the water through falling from the structure, or its collapse.

Another such site is Kessel, located on the River Meuse in the Netherlands (ter Schegget, 1999), which has been interpreted as a Late Iron Age cult site relating to warfare. Here, human skeletal remains represented by 650 fragmentary cranial and post-cranial bones belonging to at least 55 individuals, have been recovered from the river through dredging (ter Schegget, 1999). A significant artefactual assemblage has also been recovered from the same area, and this includes weaponry, ceramics, personal ornaments, bronze cauldrons, agriculture materials, and animal bones (ter Schegget, 1999). The analysis of the human remains conducted by ter Schegget (1999) identified that 90% of individuals were adults, and that of the bones which could be assigned to a particular sex, 75% belonged to males and 25% to females. They also report that 15 bones presented evidence of trauma, including a potential example of mutilation (ter Schegget, 1999).

Human remains recovered from Alken Enge, a 1st century AD site on Lake Mossø in Denmark, have been interpreted in terms of post-battle ritual behaviours (Mollerup et al., 2016; Søe et al., 2017; Holst et al., 2018). The remains of around 380 individuals have been recovered from the bed of the lake, along with some items of weaponry and other objects, in several excavations since the 1960s (Mollerup et al., 2016; Holst et al., 2018). Recent work on the remains has revealed them to be exclusively male, to have a high prevalence of perimortem trauma, and evidence for surface exposure (Mollerup et al., 2016; Holst et al., 2018). Many of the remains had been manipulated post-death, including four ossa coxae (pelvic bones) which had

been threaded on to sticks, and bones which presented cut and scrape marks. This was taken to be suggestive of the deliberate deposition of the remains in the lake as part of a ritualised clearance of the battlefield (Holst et al., 2018). Materials belonging to later periods recovered from the same area have been interpreted as continuations of ritualised deposition, potentially initiated by this large scale battle event (Søe et al., 2017).

A number of additional assemblages of human remains from watery contexts have been interpreted in terms of ritual deposition, without being directly associated with significant metalwork or artefactual assemblages. The bog bodies discussed above provide an example of this, but a number are known from other contexts as well. From Britain, the sites of Godwin Ridge in Cambridgeshire (Evans, 2013) and Eton Rowing Course on the Middle Thames (Allen et al., 2000) are two particularly notable examples in terms of the numbers of human remains recovered and their excavation under modern conditions.

Godwin Ridge, a sand bank within a palaeochannel of the River Great Ouse in Cambridgeshire, has been interpreted as a major site involving the riverine interment of human remains during the Late Iron Age (Evans, 2013). Eighty-nine human skeletal elements were recovered, including portions of seven crania from at least five adults (Evans, 2013). Many of the remains had been manipulated in the peri- or postmortem periods: four circular holes had been drilled into one cranial fragment in the postmortem period, and perimortem cut marks were noted on a scapula, humerus, and a rib, and were taken to be indicative of dismemberment (Evans, 2013). The occurrence of the human remains alongside vast quantities of bird bones, a gravel platform, and carefully placed animal remains led to the conclusion that "at least locally, the riverine deposition of bodies and body parts associated with animal/bird sacrifice and, probably, feasting was one of the period's main interment rites" (Evans, 2013:76).

Eton Rowing Course is another important site interpreted in terms of the deposition of human remains as part of a prehistoric funerary ritual (Allen et al., 2000). At this multi-period site, human remains were recovered from various contexts within palaeochannels of the River Thames: Neolithic individuals from the base of the palaeochannels, Late Bronze Age individuals from a former mid-channel sandbank, probable Late Bronze Age individuals from an area downstream of the sandbank, and Iron Age individuals found alongside wooden structures (Allen et al., 2000).

Some Late Bronze Age individuals, represented by isolated long bones, presented potential evidence for defleshing in the form of fine cut marks (Allen et al., 2000:90). The assemblage was dominated by crania, though multiple postcranial bones were also present (Allen et al., 2000). This led the authors to infer a degree of selective deposition, though they also acknowledged the potential role of taphonomic factors (Allen et al., 2000). The association of the human remains with other features, such as whole pots placed upright in the sandbank, and upright wooden stakes, was taken to be particularly indicative of deposition in a ritual context (Allen et al., 2000:95).

2.2.2 Other interpretations of deposition

Not all archaeological human remains recovered from watery environments have been interpreted in terms of ritualised deposition in water. Some notable interpretations and sites are reviewed here.

Certain sites have been connected to catastrophic events, such as battles. One particularly noteworthy example is the Tollense River Valley in Germany, where around 2,900 human bones have been recovered from around 16 sites across a 2 km stretch of river, along with vast quantities of weaponry and horse bones (Jantzen et al., 2011; Brinker et al., 2013). Recent excavations, along with bioarchaeological and taphonomic studies demonstrating a male bias and evidence of violence, have led to the interpretation that the remains originated from a large battle in the Bronze Age, around 1200 BC (Jantzen et al., 2011; Brinker et al., 2013; Flohr et al., 2014). It was hypothesised that the bodies were left exposed on the riverbanks or sandbanks after the battle, and some were subsequently washed out into the main river channel during episodes of flooding.

A number of human remains from watery environments, particularly isolated occurrences of human remains, have been interpreted in anecdotal terms; e.g., murder and the disposal of bodies, or accidental death. The theme of accidental death has featured particularly as an interpretative explanation in the more recent, Medieval and Post-Medieval periods. For example, discussing Post-Medieval bog bodies, Turner (1995:10) tells the tale of two men who drowned in Lindow Moss in 1853 after attempting to cross the bog while “loaded with ale”. Similar interpretations have also been raised in relation to the human remains from the River Thames, which are discussed further in Chapter 3.

Other assemblages of human remains have been associated with the erosion of dryland burials. Over the centuries, vast numbers of human crania have been recovered from the River Walbrook deposits in London, a tributary of the River Thames. These remains have been interpreted in various ways, from the victims of Boudicca's attack of London in AD 60 (Wheeler, 1928), to the deposition of heads in "Celtic religious practices" relating to the importance of the head and watery environments (Marsh and West, 1981). As will be outlined in Chapter 3, these discussions have played into the debates surrounding the human remains from the main River Thames channel. However, recent excavations of a Roman period cemetery site in the Upper Walbrook Valley, which is located upstream of the areas from which the antiquarian cranial finds were recovered, have revealed evidence of the fluvial disturbance of burials from flooding (Harward et al., 2015:126-133). In addition, a taphonomic re-examination of the physical remains revealed many changes usually associated with fluvial transport (e.g., polishing of the bone surface). Together, these observations were taken to be strongly suggestive that the majority of the Walbrook human remains likely originated from the erosion and subsequent fluvial transport of human remains from the cemetery site (Harward et al., 2015:126-133).

Fluvial processes have also been favoured in explaining the human skeletal remains excavated from the River Ribble in Lancashire (Turner et al., 2002). Twenty human crania were found in close spatial proximity, but yielded a wide range of radiocarbon dates, from the Neolithic to the Medieval periods (Turner et al., 2002). This chronological patterning, together with taphonomic evidence for fluvial transport, led the authors to conclude that while the reasons for the initial entry of the bodies into water may have been diverse, and could include some form of ritualistic process, accidental death, or interpersonal violence, only natural fluvial processes need to be invoked when accounting for the presence of crania in the River Ribble deposits (Turner et al., 2002).

2.3 Chapter summary

This chapter has highlighted a range of interpretations of human remains which have been recovered from watery places in northwest Europe, considering evidence across various time periods. The discussion has been organised thematically: first considering human remains which have been explained in terms of ritual deposition

in water, followed by those interpreted in more prosaic terms. Although this has been a useful broad framework through which to consider previous interpretations of human remains from watery places, it should be noted that these are not rigid, binary, distinctions (e.g., see the definition of ritual in Section 1.3.2). The ritual deposition of human remains in water appears to have been a variable practice through time and space, perhaps even at the local level, as has been suggested by others (e.g., van der Sanden, 2012; Schulting and Bradley, 2013; Giles, 2020). However, some broad themes which have been emphasised include the association of human remains with artefactual assemblages, evidence for violence, and the potential peri- or postmortem manipulation of human remains. A number of sites in northwest Europe have been interpreted in terms of ritual deposition directly relating to the domain of warfare.

Chapter 3 The River Thames

This chapter first provides an overview of various aspects of the Lower Thames through time (Section 3.1). This is followed by an overview of the archaeological artefacts and human remains which have been recovered from the Lower Thames (Section 3.2). The chapter concludes with a discussion of the previous scholarship relating to the human remains recovered from the Lower Thames (Section 3.2.3.1).

3.1 The Lower Thames through time

The following section provides an overview of the Lower Thames from the Neolithic to the Post-Medieval periods. It is organised around themes of environment and river dynamics (Section 3.1.1), settlement patterns (Section 3.1.2), and funerary practice (Section 3.1.3). Within these themes, the discussions are organised broadly chronologically. Although discussion is focused on the Lower Thames Valley, consideration is also given to evidence from the Middle and Upper Thames Valleys where appropriate.

3.1.1 Environment and river dynamics

The River Thames, which flows west to east from the Cotswolds to the North Sea, adopted its current trajectory during the Anglian glaciation (c. 480,000 years ago) (Bridgland, 1995). The river was a braided system throughout much of the Pleistocene, and appears to have adopted its single channel form at some point during the Early Holocene (11,000-9,500 cal BC), probably owing to a loss of flow due climatic change (Sidell et al., 2000:14,107; Morigi, 2011:174). Evidence from central London suggests that at this time the river would have been relatively shallow, meandering, and probably with a low flow velocity (Sidell et al., 2000:107). Throughout the Mesolithic the river appears to have been well constrained in its channel, and the overall picture is one of stability on the floodplain (Sidell et al., 2000:119).

The Mesolithic to Neolithic transition did not see any significant changes in river regime (Sidell and Wilkinson, 2004:40) but processes of relative sea level rise which began during the Neolithic transformed the River Thames in the area now covered by central London from an essentially freshwater system, to an estuarine one by the Late Bronze Age (Sidell et al., 2000:109). The tidal head appears to have been at

Westminster in the Late Bronze Age, and the valley-bottom landscape would have changed from one dominated by woodland to one of reed swamp, with peat development occurring on former land surfaces (Sidell et al., 2000:113,115). At Westminster and Southwark, former soil surfaces, complete with ploughing marks, were submerged under waterlain silts (Sidell et al., 2000:122). The tidal inundation may have been a relatively rapid event, taking place in the Middle or Late Bronze Age (Sidell et al., 2000:122). The submersion of riverside woodland along the River Thames has been recorded at Erith, Rainham, Bankside, and Chelsea (Cotton, 2017:24; Lewis, 2000). Further upstream of the tidal head, a rising water table led to increased flooding events in the Thames Valley from the Middle Bronze Age, and throughout the Late Bronze and Iron Ages (Lambrick and Robinson, 2009).

The marine influence gradually decreased in central London from the Late Bronze Age onwards, as the tidal head migrated back downstream through the Iron Age (Sidell et al., 2000:122). During the Roman period the tidal head appears to have been broadly in the area of *Londinium*, though it may have continued to migrate downstream, leading to the disuse of waterfront quays and jetties in the 3rd century AD (Brigham and Hillam, 1990; Hingley, 2018:15). Human activity began to substantially alter the topography of the river at this time, through the building of revetments along the river banks and the in-filling of channels between some of the multiple eyots in the area of *Londinium* (Hingley, 2018:18).

In the later Roman and Early Medieval periods the tidal head appears to have moved upstream again, and it is possible that the settlement of *Lundenwic* was placed in relation to this (Sidell et al., 2000:110; Hingley, 2018:15). After further final movement of the tidal head downstream, to around the area of London Bridge, there is then evidence for river level rise and the tidal head moving back upstream from the 12th century (Sidell et al., 2000:110). This was probably a human-induced change, resulting from the extensive riverside land reclamations which took place from the 12th century to the end of the 15th century as the city of London expanded (Dyson, 1989) and which reduced the width of the river channel by up to 80 metres on the north bank (Sloane and Harding, 2000:212). By the 14th century, evidence from the City suggests the tidal influence was much stronger than it had been in the preceding historic periods (Milne and Milne, 1982), and this trend has continued with river levels rising to the present day (Sidell et al., 2000:110).

3.1.2 Settlement

The River Thames Valley has long been an important focus of human activity and settlement, with its rich floodplain resources, and its function as an artery of communication (Sidell, 2001; Ross and Clark, 2008).

A Homo neanderthalensis cranium from the former river bed at Swanscombe, Kent, provides the earliest direct evidence of human presence (Cotton, 2017:23), but it was not until the late Holocene that there was any notable human presence in the Lower Thames Valley (Rackham and Sidell, 2000). Mesolithic activity is known from various sites, including the foreshore at Vauxhall, where six timbers have been recorded (Cotton, 2017:23). Isolated findspots of flint scatters are also known from a number of sites, with a particular concentration at Westminster (Sidell et al., 2000:119). Evidence for Neolithic settlement is rare, though this may to some extent reflect issues with site identification and preservation (Lewis, 2000). However, it has been suggested that the area now covered by greater London was a “cultural backwater” in the Neolithic, owing to unfavourable environmental conditions (Wilkinson and Sidell, 2007:85). Slightly upstream of the Lower Thames, the site of Runnymede Bridge (Needham, 1991) has been argued to represent the best evidence for Neolithic Thames-side settlement in the London area, with evidence for settlement between c. 4000-3500 BC and tentative evidence for a longhouse (Lewis, 2000:68).

In general, there is also a rarity of Early Bronze Age sites in the London area, though this may reflect a preference for river valley locations, with settlement evidence then being obscured by subsequent processes of alluviation (Brown and Cotton, 2000:90). There is more settlement evidence for the Middle Bronze Age, and by the Late Bronze Age there is evidence for a wide range of settlement types, including post-built houses and ring forts (Brown and Cotton, 2000). There is also evidence for the large scale division of land, and utilisation of the lower areas of the floodplain during this period, including eyots within the river course at Runnymede Bridge on the Middle Thames (Needham, 1991), Eton Rowing Course on the Middle Thames (Allen et al., 2000), Isleworth on the Lower Thames (Bell, 1996), and also at Whitecross Farm on the Upper Thames at Wallingford (Cromarty et al., 2006). The island/riverside site of Runnymede Bridge (Needham, 1991) has been highlighted as exceptional for its wealth of structural evidence and deeply stratified midden deposits (Brown and Cotton, 2000).

Evidence for Early Iron Age settlement sites in the London region is limited, and this has sometimes been used to suggest reduced activity compared with the preceding Late Bronze Age (Wait and Cotton, 2000). However, a picture is emerging of small-scale farmsteads, set in organised landscapes of trackways and fields, with occasional larger defended settlements of hillfort type (e.g., Caesar's Camp) (Wait and Cotton, 2000). Evidence for settlement sites is more plentiful in the Middle Iron Age, with a number of defended enclosures of hillfort type (e.g., Holwood Hill at Hayes, Uphall Camp at Ilford) and extensive open sites (e.g., Perry Oaks, Heathrow) (Wait and Cotton, 2000). There is some circumstantial evidence for a defensive site adjacent to the River Thames at Woolwich (Greenwood, 1997).

A characteristic feature of the Late Iron Age in Britain is the development of large defended sites, or *Oppida*. Given this, the absence of evidence for a major Late Iron Age settlement site in the area of London, has long been commented on (e.g., Kent, 1978; Cotton and Wood, 1996:29). Some have framed this as a search for a nodal point of settlement, a pre-cursor to the Roman city; but, as Wait and Cotton (2000:102) emphasise, the London area probably lay at the boundaries of a number of distinct political groups in the Late Iron Age. Interestingly, recent Museum of London Archaeology excavations (for the Thames Tideway Tunnel) along the foreshore at Barn Elms are revealing evidence for a sizeable Late Iron Age settlement (Blanks, 2019).

The Roman city of *Londinium* was established on the banks of the River Thames during the Roman occupation of Britain (AD 48), and by the end of the 1st century AD had become the centre of provincial administration in Britain (Perring, 1991; Mattingly, 2006). At its maturity it was one of the largest urban centres of the western provinces (Morris, 1982; Perring, 1991) and was estimated to have had a population of around 26,000 to 30,500 people (Swain and Williams, 2008). Extensive modern development in the area of *Londinium* has revealed a wealth of archaeological evidence for this settlement, which had many of the features of Roman urban centres (e.g., a forum, baths, and an amphitheatre) (Perring, 1991).

Archaeological evidence suggests *Londinium* was effectively abandoned in the early 5th century AD after the collapse of Roman administration (Ayre and Wroe-Brown, 2015; Perring, 1991). There was then a general hiatus in settlement until the mid to late 7th century AD, which saw the development of a large settlement, *Lundenwic*, to the west of the old Roman city in the area of present day Covent Garden (Cowie

and Harding, 2000). From that time onwards, London continued to grow and expand as an urban centre through the Medieval and Post-Medieval periods to the present day.

3.1.3 Funerary practice

3.1.3.1 The Neolithic

In Britain, most recorded Neolithic burial is collective, within long barrows or chambered tombs (Bristow, 1998). Excarnation and secondary burial practices are also known (e.g., Smith, 2006). In contrast with the wealth of evidence for such burial practices in the Upper Thames Valley, the evidence from the Middle and Lower Valley areas is relatively sparse (Lamdin-Whymark, 2008:198; Coles et al., 2008). In the Middle Thames Valley, a small number of Early and Middle Neolithic human remains have been recovered from a range of contexts including monuments, flat graves, and pits (Lamdin-Whymark, 2008). At Eton Rowing Course on the Middle Thames, the human remains of Neolithic date included: two crouched inhumations, one skull fragment in a pit, and four elements recovered from the palaeochannel (two crania, a finger bone, and a partially articulated skeleton) (Allen et al., 2000). Lamdin-Whymark (2008:197) speculated that there is some evidence for excarnation practices and the circulation of bone in the Middle Thames Valley, particularly at Staines Causewayed enclosure.

3.1.3.2 Early to Middle Bronze Age

In the Early Bronze Age, the burial record in the London area of the Lower Thames Valley, though limited, hints at a complex sequence of funerary practice, with evidence for some inhumation in ring ditches, barrows, and some cremated bone deposits (Brown and Cotton, 2000). This is broadly comparable to national patterns, but the “Wessex-type” prestige burials are rare, though some are known in the Middle Thames Valley at East Mosely and Teddington (Brown and Cotton, 2000:85). The Middle Bronze Age in Britain is traditionally understood to be a period of major funerary transition, with a homogenous and unadorned cremation-based practice emerging (Caswell and Roberts, 2018). The evidence from the Middle and Lower Thames Valleys appears to fit this general pattern, with some Middle Bronze Age cremation cemeteries identified, such as those at Imperial College Sports Ground and Eton Rowing Course (Allen et al., 2000; Brown and Cotton, 2000).

3.1.3.3 Late Bronze and Iron Age

In the Late Bronze Age and Iron Age in Britain there is a dramatic decrease in archaeologically-visible funerary practices (Brück, 1995). It has been suggested that an archaeologically visible rite was practiced for only 6% of people in the Early to Middle Iron Age (Wait, 1985:90). Instead, fragments of disarticulated, unburnt bone, as well as small quantities of cremated bone, have been recovered from various contexts including settlements, roundhouses, waterholes, and field boundaries (Brück, 1995; Booth and Brück, 2020). The deposits likely represent the endpoint of complex mortuary treatments, which could involve excarnation, the exhumation of primary burials, and the systematic curation of bone (Booth and Brück, 2020). A small, but growing, number of inhumation burials belonging to this period are also being recognised through developer-funded archaeology and the more widespread application of radiocarbon dating (McKinley, 2017).

The available burial record for the Late Bronze to Iron Age in the Middle and Lower Thames, though again sparse, seems to fit this general pattern. Small amounts of disarticulated bone of Late Bronze Age date have been recovered from a limited number of riverside sites in the Middle and Lower Thames Valleys. These sites include: Runnymede on the Middle Thames, a former eyot, where disarticulated bone was found distributed across the site (Needham, 1991); and Snowy Fielder Way, Isleworth, on the Lower Thames where fragments of bone were recovered from a ditch on a former eyot (Bell, 1996). At Whitecross Farm, Wallingford, at the lower extent of the Upper Thames, a small amount of human bone was recovered from a midden deposit on a fomer eyot (Thomas et al., 1986; Cromarty et al., 2006).

The human remains recovered from the Lower Thames aside, disarticulated bone of Late Bronze and Iron Age date has been recovered from a number of watery contexts along the Middle Thames Valley, and also the Upper Thames Valley. As described in Section 2.2.1.3, disarticulated bone of Late Bronze Age and Iron Age date has been recovered from the palaeochannels at Eton Rowing Course, some of which were reported to have been cutmarked (Allen et al., 2000). Other human bone of Late Bronze and Iron Age date has been recovered from contexts associated with waterholes. Two Late Bronze Age inhumation burials were also recovered at Eton Rowing Course, where they were located next to a disused waterhole (Allen et al., 2000). At Mount Farm, Berinsfield, on the Upper Thames, disarticulated adult and subadult bones were recovered from the upper fill of a Late Bronze Age waterhole

(Lambrick, 2008). A fragment of worked human bone was recovered from a Late Bronze Age waterhole at Reading Business Park in the Middle Thames Valley (Brossler et al., 2003). At Yarnton, on the Upper Thames, an adult humerus was recovered from a waterhole (Hey, 2006).

In the Late Iron Age, the reintroduction of cremation as a burial rite, which was widespread in South East Britain, does not appear to have been adopted in the London region (Greenwood, 1997:160; Wait and Cotton, 2000:110-112).

3.1.3.4 The Roman period and post-Roman periods

The Roman period saw the establishment of *Londinium*, and the adoption of Roman style burial traditions along with it. Large extra-mural cemeteries developed, following Roman customs which prohibited the interment of burials or cremations within settlements (Hall, 1996; Watson, 2003). Cremation burials dominated in the earlier Roman period, but became rare from the 3rd century AD, with inhumation burial becoming the common practice (Perring and Brigham, 2000:148). There is little evidence for Christian style burial practices in Roman London (Barber and Bowsher, 2000:321).

After the collapse of the Roman administration in the 5th century there is little evidence for burial on a significant scale in the area now covered by central London, a fact which probably reflects the settlement patterns (see Section 3.1.2). However, a number of inhumation, and mixed inhumation and cremation, cemeteries are known from more peripheral areas (Cowie and Harding, 2000:182). These include a sizeable inhumation cemetery of 5th to 6th century date at Mitcham, South London (Bidder, 1907). Evidence for burial on a substantial scale in the vicinity of present-day central London doesn't re-emerge until around the late 6th and 7th century (Cowie and Harding, 2000:189). Two inhumation cemeteries are known from this date, one at St Martin-in-the-Fields and another in the Covent Garden area (Cowie and Harding, 2000:189). By the 8th century most of the inhabitants of *Lundenwic* would likely have been buried in churchyards, although evidence for this is limited owing to the likely continuous use of these cemeteries in to the later Medieval period (Cowie and Harding, 2000:190). Inhumation burial in churchyards continued to be the dominant funerary practice until almost the present day.

3.2 Archaeological human remains and artefacts from the River Thames

In addition to the human remains, which form the subject of this thesis, vast quantities of archaeological artefacts have also been recovered from the River Thames. These materials have traditionally received much more attention: best known among them are the Bronze Age and Iron Age weaponry (e.g., Ehrenberg, 1980; Needham and Burgess, 1980; Fitzpatrick, 1984; York, 2002), but tools, pottery, coins, feasting equipment, and personal ornaments of all periods are among the find classes represented. This section provides a summary of the history of the recovery of human remains and artefacts from the river, followed by an account of the various ways in which the human remains have been interpreted to date. A more specific account of the collection history of the River Thames and Maynard Reservoir human remains assemblages is given in Chapter 5, Sections 5.1.3 and 5.2, respectively.

3.2.1 The "Golden Age" of Thames finds

The recovery of archaeological artefacts and human skeletal remains from the River Thames has a long history. Although the recovery of artefacts is known from earlier periods (e.g., a gold torc found at Isleworth in 1467 (Hume, 1956)), the majority of these archaeological materials now in museum collections are the result of 19th and early 20th century antiquarian collecting activities. This period was so prolific in terms of the quantity and quality of finds, that it was dubbed the "golden age" of Thames finds (Lawrence, 1929).

The materials collected during this period were primarily recovered through the extensive dredging of the riverbed which was taking place at the time in order to maintain navigation channels and provide ballast for ships (Cotton, 1999). The dredging methods employed allowed dredgermen to inspect the raised gravels for finds, and they then sold these on to various collectors, including Thomas Layton, Charles Roach Smith, and George Fabian Lawrence (Hume, 1957:23). Large-scale construction projects along the River Thames, such as the construction of the new London Bridge between 1824 and 1831 and the sewer improvements of the 1860s, also yielded numerous finds (Cotton, 1999; Cohen and Wragg, 2017).

Vast quantities of metalwork were encountered during these activities, with the elaborate pieces of La Téne metalwork, such as the Waterloo Helmet and the

Battersea Shield perhaps the best known of the finds recovered (Figure 3.1). The human remains recovered may have been equally prolific in number, though many are “paper finds”, currently unaccounted for in museum collections (Section 5.1.3). Writing in 1857, H.S. Cuming described a location near Battersea Bridge as “our Celtic Golgotha”, owing to the number of crania recovered (Cuming, 1857:238). According to G.F. Lawrence, over 100 skulls were found at Strand-on-the-Green near Oliver’s Island (Lawrence, 1929:81).

Figure 3.1: The Battersea Shield (A) and the Waterloo Helmet (B). These are elaborate pieces of Late Iron Age, La Téne, metalwork recovered from the River Thames during the 1800s. © The Trustees of the British Museum.

3.2.2 The end of the golden age?

In 1929, G.F. Lawrence declared that the “Golden Age” of Thames finds was over, owing to altered dredging patterns (Lawrence, 1929:71). However, the recovery of human remains from the river did not cease at this point. Many more human remains have been recovered from the river foreshore and riparian zone in recent decades, through construction works, archaeological excavation, via mudlarks (a term used for those who regularly search the foreshore for artefacts under licence from the Port of London Authority) and, importantly, systematic programmes of foreshore archaeology delivered through the Thames Archaeological Survey (TAS) from 1996-1999 and the Thames Discovery Programme (TDP) since 2008 (see Cohen, 2017).

3.2.3 Previous scholarship on the human remains from the River Thames

> "Promiscuous heaps of slain laid there,
> Their life gore tinged the water clear,
> Spreading around the ruddy stain,
> Which marked the spot of strife and pain"
> (Cuming, 1857:239)

The above quotation is taken from the first published account of the human remains recovered from the River Thames: *On the discovery of celtic crania in the vicinity of London*, written in 1857 by H.S. Cuming, an antiquarian collector (Cuming, 1857). In this, Cuming describes how numerous human crania had been encountered during the construction of a new suspension bridge in the Battersea area between 1854 and 1855. On the basis of this description, the bridge in question can be assumed to be Victoria Bridge (constructed 1851-1858), which was later replaced by Chelsea Bridge. The crania were reported to have been "mingled with weapons of bronze and iron" (1857:237). Further reports of weaponry recovered from the same area followed a year later, and included the Battersea shield (Cuming, 1858).

Cuming (1857), quite imaginatively, interpreted the crania as the remnants of a past battle between the "*Celtæ*" and the "*Romans*", primarily on the basis of his observations that the crania were of "two distinct types" and the presence of weaponry with the remains:

"The inferences deducible from these facts are, that a *melée* took place between the *Celtæ* and the *Romans* near the western bank of the Thames, and that the former were driven into it by their assailants, some of whom, however, were carried into the stream with them- friend and foe alike perishing together" (Cuming, 1857:239)

The early association of the cranial morphology of the remains with population affinity is interesting, given that this concept would form a central part of debates surrounding the depositional origins of the remains more than a hundred years later, as will be described in the following sections. Cuming makes no comment about whether mandibular or post-cranial bones were found alongside the crania.

The human remains were not the subject of focussed description again until the 1890s when G.F. Lawrence and J.G. Garson presented a group of 15 crania which had been recovered via dredging to the Royal Anthropological Institute. These publications were more pragmatic in approach, and did not attempt to account for the deposition of the remains. Lawrence detailed their find locations and geological positions (Lawrence, 1891) and Garson provided anatomical descriptions (Garson, 1891). These crania formed a part of the Thames assemblage in this thesis, as they can be identified in the collections of the Natural History Museum, London (see Section 5.1.3 for further description).

It appears that the human remains were then largely forgotten for nearly a century, overshadowed by the metalwork which has formed the focus of numerous publications on Thames finds (e.g., Lawrence, 1929; Hume, 1956; Ehrenberg, 1980; Needham and Burgess, 1980; Fitzpatrick, 1984). However, in 1988, an article was published in *Antiquity* by Richard Bradley and Ken Gordon (Bradley and Gordon, 1988) which brought the River Thames crania into the spotlight once more and sparked decades of debate over their depositional origins.

3.2.3.1 Debated depositional origins

Bradley and Gordon’s (1988) study was inspired by observations that metalwork from watery contexts often resembled that found in graves, and also by previous work by Marsh and West (1981) on human crania recovered from the Walbrook stream, a tributary of the Thames. Marsh and West (1981) argued that the Walbrook crania were likely to be Romano-British in date (on the basis of craniometric measurements), and to have been deposited as disarticulated crania in a continuation of “Celtic religious practices” relating to the importance of the head and watery environments.

Turning their attention to the more numerus River Thames crania, Bradley and Gordon (1988) studied 299 crania and 14 mandibles which had been recovered from the river between Oxford and the Thames Estuary. They suggested the results of their study provided “a measure of support for those who see a relationship between the weaponry deposited in major rivers and the types of artefacts placed in earlier graves” (Bradley and Gordon, 1988:508).

Two years later, this idea was presented in detail by Bradley in their seminal work on prehistoric votive deposition, the *Passage of Arms* (1990 (1998)). Bradley's work built on the study of Torbrügge (1971), who observed various relationships between the vast amounts of Bronze Age weaponry recovered from rivers, and that which was found in dryland burial contexts. Providing an example relevant to British contexts, Bradley notes that in the Early Bronze Age most daggers have been found in graves but dirks and rapiers, their successors, are mainly found in watery contexts and are rare in burials (Bradley, 1998:100). Bradley goes on to suggest that, "rather than bury individuals beneath a sizeable mound, bodies may have been deposited in watery locations, with fine metalwork of the types that would normally have been placed in the grave" (1998:107).

Returning to Bradley and Gordon's (1988) work on the human remains from the River Thames, their interpretation of deposition was based on the apparent existence of a geographical and chronological relationship between the metalwork and the crania: both having been recovered from the same stretches of the river, and being of similar Late Bronze Age date. Chronological assessment of the remains was attempted through craniometric analysis and radiocarbon dating of six crania. Assigning a relative date to human remains through craniometric analysis is problematic, as acknowledged by the authors at the time. However, the provision of radiocarbon dates was a significant step forward. The demography of the assemblage, with 60% estimated to be adult males, was also invoked to support this position. The over-representation of cranial remains in the assemblage was connected with ideas of excarnation, followed by the deposition of isolated crania.

This work was followed, several years later, by a publication by Christopher Knüsel and Gillian Carr (1995), also in *Antiquity*, in which issue was taken with the interpretations of Bradley and Gordon (1988). Knüsel and Carr (1995) studied 182 Thames crania, and concluded instead that the majority of the River Thames assemblage was likely to have arisen through the erosion of riverside burials and as the bodies of drowning victims, which were subsequently fluvially-sorted to produce deposits of crania which have accumulated through time. Potential associations of crania and metalwork were considered to be incidental, both the result of fluvial processes.

Knüsel and Carr (1995) drew on three main lines of evidence to support their stance: taphonomic evidence, the dating of the remains, and the demographic

profile of the remains. Firstly, the over-representation of crania in the assemblage was argued to reflect taphonomic processes, rather than the deposition of isolated crania. This argument was based on modern forensic studies which have observed that complete crania are the fastest moving skeletal element in water, and are often transported far from their original place of entry to the water and away from the rest of the skeletal elements they may have entered the water with (Boaz and Behrensmeyer, 1976; Nawrocki et al., 1997). Crania are then later deposited where river dynamics allow (e.g., backwater areas, or river bends) (Boaz and Behrensmeyer, 1976; Nawrocki et al., 1997; Knüsel and Carr, 1995). The fact that many of the crania had lost the facial bones, and the lack of subadult bones among the remains, were also argued to indicate the presence of fluvial accumulations.

Secondly, Knüsel and Carr (1995) also considered that there was no strong evidence for a temporal relationship between the metalwork and the crania. They highlighted the issues associated with assigning relative dates to the remains on the basis of craniometric measurements, and considered that the wide temporal span of the six radiocarbon dates provided by Bradley and Gordon (1988) (Neolithic to Early Medieval) meant the remaining undated individuals could belong to any period in the date range.

Finally, Knüsel and Carr (1995) also highlighted the over-representation of adult males in the assemblage, similarly to Bradley and Gordon (1988). However, they argued that this was consistent with the demographic profile of 20th century drowning victims and may relate to a higher accident and suicide rate for males at various times in the past.

This article occasioned a short response from Bradley (1995), in which they conceded that taphonomic processes may have given rise to the accumulations of crania, that the use of craniometric data to estimate the date of the remains was problematic, and that the dates obtained did present a wide span, but maintained their original position. They re-emphasised the existence of a spatial relationship between the metalwork and the crania, both in the River Thames and in other British and continental European sites. Criticism was also levelled at the use of contemporary drowning statistics to infer the presence of suicide victims in the assemblage. This was deemed inappropriate as such practices are highly culturally-specific.

A further response to the Knüsel and Carr (1995) article appeared in *Antiquity* a year later, written by Barbara West (West, 1996), who had co-authored the initial 1981 article on the Walbrook crania (Marsh and West, 1981). In their response, West (1996) took issue with the suggestion of Knüsel and Carr that their fluvial accumulation argument could also be applied to the Walbrook crania. They argued that the Walbrook crania demonstrated generally good preservation and completeness, and also that the use of craniometric data to provide population affinities and, by extension, relative dates for the remains was a valid approach. This was followed in the same issue by a brief comment by Knüsel and Carr (1996) who clarified their position that craniometric data cannot be used to date the remains "measurements of the cranial vault are too crude to separate closely spaced, time-successive populations within a restricted geographic region with any precision" (Knüsel and Carr, 1996:190). They conclude that though there is good evidence for the ritual importance of watery places in European prehistory, the "assertion that crania found without a well-recorded context in rivers are good analogies for those found in context is not sufficiently supported" (Knüsel and Carr, 1996:190).

After a hiatus of just over a decade, Yvonne Edwards et al., (2009) published a focused study of 18 River Thames and Walbrook crania, which included the production of seven new radiocarbon dates. Again, these dates ranged from the Neolithic to Medieval periods, but presented a bias towards the Bronze Age. The study examined various taphonomic indicators and the demography of the individuals. The authors did not adopt a particular position regarding the deposition of the remains, but appeared to favour ideas of selective deposition of crania for at least some of the human remains from the River Thames, based on the occurrence of isolated skulls at other riverine sites (Edwards et al., 2009:47). This work included two crania recovered from the present day foreshore and thus represented the first attempt to consider this material alongside the antiquarian remains.

The most recent piece of focused scholarship on the human remains from the River Thames was conducted in 2013 by Rick Schulting and Richard Bradley (Schulting and Bradley, 2013). The authors examined 150 of the River Thames crania for evidence of skeletal trauma and produced radiocarbon dates for eight which presented evidence of blunt force trauma, for inclusion in a project on Neolithic violence. Finding that many were actually of Late Bronze and Early Iron Age date, and not Neolithic as they had anticipated, they chose to revisit the depositional origins of the remains.

The authors largely re-emphasised the original interpretations of Bradley and Gordon from 1988, arguing for "the ritual deposition of a significant proportion of heads or defleshed crania into, or in wet places immediately alongside, the Thames" (Schulting and Bradley, 2013:68). This conclusion was based on three main lines of argument: 1) the existence of broad spatial relationships between the weaponry and the crania, though it was acknowledged this is not without issue given the lack of geographic specificity of dredged remains and the possibility that the crania have been fluvially transported; 2) the chronological overlap between the dated crania and the weaponry and; 3) the fact that the majority of crania are unlikely to have entered the river via the erosion of riverside burials as, during the peak periods of deposition, either cremation was the dominant mortuary rite or there is little specific evidence for mortuary practices in the region at all.

3.2.3.2 Summary

To summarise the above, although some of the authors acknowledged at various times that the depositional origins of the human remains from the River Thames are likely to be diverse (e.g., Schulting and Bradley, 2013:68), two main lines of debate have developed within the existing literature. One views the human remains as evidence for the selective deposition of crania directly into the river, or in wet places alongside it, as part of later prehistoric funerary practices associated with the votive deposition of weaponry (Bradley and Gordon, 1988; Bradley, 1995; West, 1996; Schulting and Bradley, 2013). The other argues for the importance of the action of fluvial processes through time, with the remains likely to represent the erosion of riverside burials and the bodies of drowning victims (Knüsel and Carr, 1995, 1996).

Various caveats can be applied these previous studies. For example, all previous studies have considered the human remains recovered from the River Thames as a single whole, despite the demonstrable chronological and geographical diversity.

All previous studies of the Thames assemblage have also, though to varying extents, arguably invested too much significance in the over-representation of isolated crania in the assemblage. This is primarily owing to the likelihood that post-depositional biases have influenced the composition of the River Thames assemblage (see Chapter 6, Section 6.3.2). However, another reason is that, although it certainly can be considered to be a feature of some ritualised deposition practices (e.g., Schulting and Bradley, 2013:67-68), the selective deposition of

crania is not a necessary component of more ritualised forms of deposition (as identified through the examples discussed in Chapter 2, e.g., Flag Fen). Additionally, and conversely, the presence of fluvially-accumulated cranial assemblages doesn't preclude their original deposition in a ritualised context, as has been raised previously by Schulting and Bradley (2013).

Furthermore, the metalwork evidence does not form a central line of enquiry in this thesis, although it is considered in the final discussion chapter (Chapter 9). Although an association between the metalwork and the human remains was a central part of the argument of Bradley and Gordon (1988), with Bradley stating that they knew of "no concentrations of crania in complete isolation, nor do I know of any from the numerous British rivers where metalwork is seemingly absent" (Bradley, 1995:168), this can no longer be considered accurate. As outlined in Chapter 2, recent excavations in controlled conditions, including those at Eton Riverside (Allen et al., 2000) and Godwin Ridge (Evans, 2013), have revealed Bronze and Iron Age human remains from riverine contexts, indicative of ritualised deposition, where metalwork is seemingly absent, at least in the immediate vicinity of the human remains.

As outlined in Chapter 1, this thesis aims to examine the deposition of the River Thames assemblage by adopting a broad approach, integrating multiple lines of new data on the physical remains themselves. This study does not seek to prove a particular "ritual" or "non-ritual" position regarding deposition: as illustrated in the review of human remains from watery environments (Chapter 2), a plethora of different potential depositional scenarios exist for the River Thames assemblage, across and within time periods.

Chapter 4 Methods

The following chapter presents the methodologies used to address the aims of the research, as outlined in Section 1.2. First, the methodology used to define and characterise the River Thames and Maynard Reservoir assemblages is given (Section 4.1). This is followed by a description of the methods used to address Aim A, to enhance understandings of temporal patterning (Section 4.2); the methods used to address Aim B, to examine the post-death taphonomic histories of the assemblages (Section 4.3); the methods used to address Aim C, to examine the demographic profile of the assemblages (Section 4.4); the methods used to examine Aim D, to examine the prevalence and patterns of violence-related trauma (Section 4.5); and finally, those used to address Aim E, to investigate the dietary compositions of individuals within the assemblages, through the application of carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulphur ($\delta^{34}S$) isotopic analysis (Section 4.6).

4.1 Defining the River Thames and Maynard Reservoir human remains assemblages

4.1.1 The River Thames assemblage

4.1.1.1 Assemblage selection

In this thesis, the River Thames assemblage includes human remains recovered from the lower reaches of the River Thames, broadly defined as the tidal stretch from Teddington Lock to the Thames Estuary. The assemblage also includes some remains recovered from the broader riparian zone (i.e., present day dryland sites). Such remains were only included if they were known, or strongly suspected, to have been recovered from deposits associated with the main river channel (e.g., alluvial deposits). These were included as they have the potential to provide context for interpreting the main river remains. For example, human skeletal remains have been recovered from former Thames palaeochannels, which are now terrestrial contexts, at the Eton Rowing Course site on the Middle Thames (Allen et al., 2000).

The assemblage catalogue, presented in Table 4.1, was compiled by conducting searches of the museum catalogues at the Natural History Museum, London (NHM) and the Museum of London (MOL), which were both known to curate human remains from the River Thames. Human remains held outside of these two

institutions were identified through Historic Environment Record (HER) searches, literature review, and active enquiry among the River Thames archaeological community (e.g., discussions with the Thames Discovery Programme). Once located, further searches were conducted to find out whether additional context information was available for the remains. This was conducted through searches of published literature, grey literature, and the relevant museum archives. For example, individual GEN01 56 is the partial skeleton of a subadult curated at the Museum of London, and for which the only archive information is that they were recovered from Hays Wharf, Southwark. Unfortunately no further contextual information could be uncovered for this individual, despite extensive searches through the aforementioned sources.

Efforts were made to access and osteologically record all of the human remains identified through this search, and these form the “osteological assemblage”. However, it was not possible to access a small number of remains (14 individuals) either because their current location could not be ascertained, or access was not permitted (e.g., some remains are held by the various police forces working in the City and Greater London area). These individuals are termed the “non-osteological assemblage”. It was deemed important to still include these individuals within the scope of the study however, as many are recent finds with contextual information, and many also have associated radiocarbon dates. Therefore they had the potential to contribute substantially to interpretations of the wider assemblage. Wherever the recording methodologies differed for these non-osteological assemblage individuals, this is indicated in the relevant sections of the following chapter. Whether specific human remains formed part of the osteological assemblage, or the non-osteological assemblage, is indicated in Table 4.1

4.1.1.2 Classifying the assemblage

Several key pieces of information were documented for each individual where available, and these are detailed below.

4.1.1.2.1 Recovery deposit

The nature of the deposit from which the human remains were recovered was recorded as either: main river channel, modern foreshore, former foreshore, or other associated deposits. The associated deposits category is a general category and

was assigned either when remains were recovered from deposits known, or suspected to be, associated with the river (e.g., probable alluvial deposits/flood deposits/marshy land alongside the river), or where the remains were strongly linked to the River Thames, but no specific recovery deposit information was available (e.g., SK 4137, a calvarium recorded as being from the Thames at Deptford, and present in the Natural History Museum collections with an accompanying box of river pebbles, noted as have been found with the remains).

4.1.1.2.2 Method and date of recovery

The recovery method was classified for remains as either: dredged, probably dredged, foreshore surface find, construction, archaeological excavation, or unknown. Remains were assigned as probably dredged when no explicit information on their method of recovery existed, but they were strongly associated with other remains known to have been dredged: e.g., they had the same location information, and/or their description strongly indicates that they were dredged (e.g., SK 4089 "from Thames alluvium, Mortlake"). The date of recovery was noted where recorded. Occasionally this was limited to a *terminus ante quem*, as it was unclear whether the associated date related to the date of recovery or accession.

4.1.1.2.3 Skeletal element type

To gain an estimate of the number of individuals present in the assemblage, the human remains were broadly classified as being either a single skeletal element (e.g., cranium), articulated elements (a maximum of two separate, refitting skeletal elements: e.g., a cranium and corresponding mandible), or an articulated skeleton (more than two refitting skeletal elements). Collectively, these different element types are termed "elements" throughout this thesis. Terms traditionally used to describe human remains encountered on archaeological sites, such as "disarticulated" or "inhumation", have not been used in general, as they imply knowledge of the context from which they were removed, which does not exist for many elements in the River Thames assemblage.

4.1.1.2.4 Spatial information

Where possible, the human remains were assigned geographical coordinates based on information about their find spot location. For some, the coordinates assigned

represent the exact find location, but for the majority they are more arbitrarily assigned, as the find locations are only known from general descriptions (e.g., Mortlake). Where multiple individuals were recorded from the same general location, and it was not known whether they were found together or on separate occasions, they were given the same coordinates and represent a single find spot. However, if more than one individual was recorded from the same general location, but it was known they were not found together in the same exact location, they were given different coordinates and represent separate find spots (e.g., GEN01 4863 and FSW08 1, both recovered from the foreshore at Surrey Docks Farm on separate occasions). One of three classifications of find spot specificity was assigned to each individual in order to reflect the varying accuracy of the coordinates assigned: exact, approximate, or general. This has been done in order to assist with interpretations of geographical patterning. The criteria for each classification are outlined below:

- **Exact location:** Almost exact location given from find spot coordinates or very detailed description/photographs of find spot. Can include building name or street name. Low error (<50 metre radius).
- **Approximate location:** General description of a find spot that allows identification of a fairly small potential find radius (~200 metre radius). E.g., "Chelsea Bridge" or "near Waterloo Station" or "near Battersea Bridge". Given in quotation marks. Coordinates assigned arbitrarily within this area.
- **General location**: Broad description of find spot area, but with a wide potential find radius. Such as "Mortlake", or "between Battersea and Vauxhall Bridge". Coordinates assigned arbitrarily.

Location Zones

To facilitate analyses of broad patterns in the spatial distribution of individuals, the river was divided into eight zones of approximately 5 km, labelled A to H from west to east. Zones A and H which represent the most westerly and easterly extremes and encompass larger distances. Each individual was assigned to one of these zones, based on their recovery location information. A general “Thames” location zone was created for remains without more specific recovery location information.

Table 4.1: The River Thames assemblage catalogue. “SK ID” is the unique skeletal identifier used in this thesis. These are official identifiers used by the curating repository wherever these were available. Where an official identifier was not available, one was created: these are indicated with an asterisk. N.B., SK IDs for all remains with NHM listed as the curating repository are prefixed with "NHMUK PA". “ALT ID” provides any alternative ID numbers which have previously been used. The “Location” column provides a description of the geographical recovery location. “Repository” is the institution where the remains are currently curated. “MOL” is the Museum of London, “NHM” is the Natural History Museum, London, “TDP” is the Thames Discovery Programme, “PAS” is the Portable Antiquities Scheme. “Zone” refers to the location zone as defined in Section 4.1.1.2.4. “Element” is as defined in Section 4.3.2. “Deposit” is as defined in Section 4.1.1.2.1 and “Recovery” is as defined in Section 4.1.1.2.2 . “Osteo data?” refers to whether or not the individual was included in the osteological dataset (i.e., analysed at first hand by the author), see Sections 4.1.1.1 and 5.1.1.

SK ID	**ALT ID**	**Location**	**Repository**	**Zone**	**Element**	**Deposit**	**Recovery**	**Osteo data?**	**Note**
2019.8	-	Putney	MOL	D	Cranial fragment	Present foreshore	Foreshore surface find	Yes	-
BATT30 1	-	Battersea Power Station	MOL	E	Cranium	Main channel	Construction work	Yes	-
Burial 1*	-	Bull Wharf	MOL	F	Articulated skeleton	Former foreshore	Arch' excavation	No	(Ayre and Wroe-Brown, 2015)
Burial 2*	-	Bull Wharf	MOL	F	Articulated skeleton	Former foreshore	Arch' excavation	No	(Ayre and Wroe-Brown, 2015)
Burrells 1*	-	Burrells Wharf	MOL	G	Articulated skeleton	Present foreshore	Foreshore surface find	No	(Cohen et al., 2013)
CC188 1	-	Cyclops Wharf	MOL	G	Articulated skeleton	Associated deposits	Arch' excavation	No	(Williams, 1988)
Chambers 1*	-	Chambers Wharf	Unknown	F	Articulated skeleton	Former foreshore	Arch' excavation	No	(MOLAHeadland , 2018)
Chambers 2*	-	Chambers Wharf	Unknown	F	Articulated skeleton	Present foreshore	Foreshore surface find	No	(Bayliss et al., 2004)

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
Chelsea 1*	-	Chelsea (FKN01)	Unknown	E	Femur	Present foreshore	Foreshore surface find	No	-
City 1*	-	City	TDP	F	Mandible	Present foreshore	Foreshore surface find	Yes	-
FKN01 Femur1*	-	Chelsea (FKN01)	Unknown	E	Femur	Present foreshore	Foreshore surface find	No	-
FKN01 Femur2*	-	Chelsea (FKN01)	Unknown	E	Femur	Present foreshore	Foreshore surface find	No	-
FSW 01*	-	Chambers Wharf	TDP	F	Cranial fragment	Present foreshore	Foreshore surface find	Yes	-
FSW08 1*	-	Surrey Docks Farm	TDP	G	Mandible	Present foreshore	Foreshore surface find	Yes	-
FTH01 1*	-	Tower of London	TDP	F	Cranial fragment	Present foreshore	Foreshore surface find	Yes	-
FWM06 1*	-	Victoria Tower Gardens	TDP	F	Calotte	Present foreshore	Foreshore surface find	Yes	-
FWW 03*	-	Putney	TDP	D	Calotte	Present foreshore	Foreshore surface find	Yes	-
GEN01 26	-	Brentford	MOL	B	Cranium	Main channel	Probably dredged	Yes	-
GEN01 27	-	Mortlake	MOL	C	Cranium	Main channel	Probably dredged	Yes	-
GEN01 28	-	Mortlake	MOL	C	Cranium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
GEN01 29	-	Mortlake	MOL	C	Cranium	Main channel	Probably dredged	Yes	-
GEN01 30	-	Mortlake	MOL	C	Cranium	Main channel	Probably dredged	Yes	-
GEN01 31	-	Kew	MOL	B	Cranium	Main channel	Probably dredged	Yes	-
GEN01 43	-	Barn Elms	MOL	C	Cranium	Main channel	Probably dredged	Yes	-
GEN01 46	-	Mortlake	MOL	C	Calvarium	Main channel	Probably dredged	Yes	-
GEN01 4856	-	Putney	MOL	D	Cranial fragment	Present foreshore	Foreshore surface find	Yes	-
GEN01 4863	-	Surrey Docks Farm	MOL	G	Cranium	Present foreshore	Foreshore surface find	Yes	-
GEN01 49	-	Thames	MOL	T	Calotte	Main channel	Dredged	Yes	-
GEN01 50	-	Mortlake	MOL	C	Calotte	Main channel	Probably dredged	Yes	-
GEN01 51	-	Putney	MOL	D	Calotte	Present foreshore	Foreshore surface find	Yes	-
GEN01 52	-	Syon Reach	MOL	B	Calvarium	Main channel	Unknown	Yes	-
GEN01 53	-	Mortlake	MOL	C	Calotte	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
GEN01 54	-	Mortlake	MOL	C	Calvarium	Main channel	Probably dredged	Yes	-
GEN01 55	-	Barn Elms	MOL	D	Mandible	Main channel	Probably dredged	Yes	-
GEN01 56	-	Hays Wharf	MOL	F	Articulated skeleton	Associated deposits	Unknown	Yes	-
GEN01 58	-	Hammersmith Bridge	MOL	C	Calvarium	Main channel	Dredged	Yes	-
GEN01 59	-	Chelsea (FKN01)	MOL	E	Calotte	Present foreshore	Foreshore surface find	Yes	-
GEN01 80	-	Wandsworth	MOL	D	Cranium	Main channel	Unknown	Yes	-
E 213	-	Hampton	NHM	A	Calvarium	Main channel	Probably dredged	Yes	-
E 583	-	Twickenham	NHM	A	Calotte	Main channel	Probably dredged	Yes	-
UNREG 1414	UNREG #10/ 1862.3.12.9	Battersea	NHM	E	Cranium	Main channel	Probably dredged	Yes	-
UNREG 6828	1862.3.21.8	Battersea	NHM	E	Cranium	Main channel	Probably dredged	Yes	-
UNREG 6829	1957.1.8.11 8	Mortlake	NHM	C	Cranial fragment	Main channel	Probably dredged	Yes	-
UNREG 7515	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
UNREG 7516	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
UNREG 7519	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
Putney 1*	-	Putney	Unknown	D	Mandible	Present foreshore	Foreshore surface find	No	-
Putney 2*	-	Putney	Unknown	D	Mandible	Present foreshore	Foreshore surface find	No	-
Putney 3*	-	Putney	PAS	D	Humerus	Present foreshore	Foreshore surface find	No	-
Putney 4*	-	Putney	PAS	D	Cranial fragment	Present foreshore	Foreshore surface find	No	-
Putney 5*	-	Putney	MOL	D	Radius	Present foreshore	Foreshore surface find	Yes	-
SK 139	-	Millbank	NHM	F	Articulated skeleton	Associated deposits	Construction work	Yes	-
SK 1436	-	Thames	NHM	T	Cranium	Main channel	Dredged	Yes	-
SK 1437	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1438	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1439	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 1440	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1441	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1442	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1443	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1444	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1445	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1446	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1447	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1448	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1449	-	Thames	NHM	T	Calotte	Main channel	Dredged	Yes	-
SK 1450	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1451	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 1452	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1453	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1454	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1455	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1456	-	Thames	NHM	T	Mandible	Main channel	Probably dredged	Yes	-
SK 1458	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1459	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1460	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1461	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1462	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1463	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1464	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-

SK ID	**ALT ID**	**Location**	**Repository**	**Zone**	**Element**	**Deposit**	**Recovery**	**Osteo data?**	**Note**
SK 1465	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1466	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1467	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1468	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1469	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1470	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1471	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1472	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1473	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1474	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1475	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1476	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 1477	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1478	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1479	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1480	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1481	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1482	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1483	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1484	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1485	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1486	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1487	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1488	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 1489	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1490	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1491	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1492	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1493	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-
SK 1494	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1495	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1496	-	Richmond Lock	NHM	B	Cranium	Main channel	Unknown	Yes	-
SK 1497	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1498	-	Thames	NHM	T	Mandible	Main channel	Dredged	Yes	-
SK 1499	-	Thames	NHM	T	Mandible	Main channel	Dredged	Yes	-
SK 1500	-	Thames	NHM	T	Mandible	Main channel	Dredged	Yes	-
SK 1506	-	Mortlake Reach	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 1507	-	Mortlake Reach	NHM	C	Cranium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 1508	-	Chiswick Reach	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 1509	-	Chiswick Reach	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 1510	-	Chiswick Reach	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 1511	-	Putney	NHM	D	Calvarium	Main channel	Probably dredged	Yes	-
SK 1512	-	Wandsworth	NHM	D	Calotte	Main channel	Dredged	Yes	-
SK 1514	-	Chelsea Bridge	NHM	E	Cranium	Main channel	Dredged	Yes	-
SK 1515	-	Battersea Bridge	NHM	E	Cranium	Main channel	Probably dredged	Yes	-
SK 1516	-	Battersea Bridge	NHM	E	Cranium	Main channel	Probably dredged	Yes	-
SK 1517	-	Battersea Bridge	NHM	E	Calvarium	Main channel	Probably dredged	Yes	-
SK 1518	-	Battersea Bridge	NHM	E	Cranium	Main channel	Probably dredged	Yes	-
SK 1520	-	Battersea Bridge	NHM	E	Cranium	Main channel	Probably dredged	Yes	-
SK 1521	-	Battersea-Vauxhall Bridge	NHM	E	Cranium	Main channel	Dredged	Yes	-
SK 1522	-	Battersea	NHM	E	Cranium	Main channel	Dredged	Yes	-
SK 1523	-	Somerset House	NHM	F	Cranium	Main channel	Dredged	Yes	-
SK 1524	-	Tower	NHM	F	Calotte	Main channel	Dredged	Yes	-
SK 1525	-	North Dock	NHM	G	Calvarium	Associated deposits	Dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 1526	-	Northfleet	NHM	H	Articulated elements	Associated deposits	Unknown	Yes	-
SK 1527	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1528	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 1529	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1530	-	Thames	NHM	T	Cranium	Main channel	Probably dredged	Yes	-
SK 1549	-	Poplar	NHM	G	Cranium	Associated deposits	Construction work	Yes	-
SK 1551	-	Whitehall Steps	NHM	F	Articulated elements	Associated deposits	Construction work	Yes	-
SK 1558	-	Waterloo Station	NHM	F	Cranium	Associated deposits	Construction work	Yes	-
SK 1563	-	Blackwall Tunnel	NHM	G	Cranium	Main channel	Construction work	Yes	-
SK 1563A	-	Blackwall Tunnel	NHM	G	Mandible	Main channel	Construction work	Yes	-
SK 19	-	Crossness	NHM	H	Calvarium	Main channel	Unknown	Yes	-
SK 4053	-	Walsall Reach	NHM	T	Calvarium	Main channel	Dredged	Yes	-
SK 4054	-	Hammersmith	NHM	C	Calvarium	Main channel	Dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 4055	-	Kew	NHM	B	Cranium	Main channel	Dredged	Yes	-
SK 4056	-	Kew	NHM	B	Calvarium	Main channel	Dredged	Yes	-
SK 4057	-	Kew-Mortlake	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 4058	-	Twickenham	NHM	A	Calotte	Main channel	Dredged	Yes	-
SK 4059	-	Kew	NHM	B	Calvarium	Main channel	Dredged	Yes	-
SK 4060	-	"Lion Reach" (Syon Reach)	NHM	B	Calvarium	Main channel	Dredged	Yes	-
SK 4061	-	Hammersmith	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4062	-	Kew	NHM	B	Cranium	Main channel	Dredged	Yes	-
SK 4063	-	Kew	NHM	B	Calotte	Main channel	Dredged	Yes	-
SK 4064	-	Kew-Mortlake	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 4065	-	Kew-Mortlake	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4066	-	Kew	NHM	B	Calotte	Main channel	Dredged	Yes	-
SK 4067	-	Kew	NHM	B	Cranium	Main channel	Dredged	Yes	-
SK 4068	-	Kew	NHM	B	Calotte	Main channel	Dredged	Yes	-
SK 4069	-	Mortlake	NHM	C	Cranium	Main channel	Probably dredged	Yes	-
SK 4070	-	Mortlake	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 4071	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4072	-	Mortlake	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 4073	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 4074	-	Mortlake	NHM	C	Calvarium	Main channel	Dredged	Yes	-
SK 4075	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4076	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4077	-	Mortlake	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4078	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-
SK 4079	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4080	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4081	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4082	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4083	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4084	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4085	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 4086	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-
SK 4087	-	Mortlake	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4088	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-
SK 4089	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-
SK 4090	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4091	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4092	-	Mortlake	NHM	C	Mandible	Main channel	Probably dredged	Yes	-
SK 4093	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-
SK 4094	-	Mortlake	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4095	-	Mortlake	NHM	C	Cranial fragment	Main channel	Dredged	Yes	-
SK 4096	-	Mortlake	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4097	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-
SK 4098	-	Mortlake	NHM	C	Calvarium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 4099	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4100	-	Mortlake	NHM	C	Cranial fragment	Main channel	Probably dredged	Yes	-
SK 4101	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4102	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4103	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4104	-	Mortlake	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4105	-	Mortlake	NHM	C	Mandible	Main channel	Probably dredged	Yes	-
SK 4106	-	Mortlake	NHM	C	Cranial fragment	Main channel	Probably dredged	Yes	-
SK 4107	-	Mortlake	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4108	-	Mortlake	NHM	C	Cranial fragment	Main channel	Dredged	Yes	-
SK 4109	-	Hammersmith	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4110	-	Hammersmith	NHM	C	Cranium	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 4111	-	Hammersmith	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4112	-	Hammersmith	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4113	-	Hammersmith	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4114	-	Hammersmith	NHM	C	Calotte	Main channel	Dredged	Yes	-
SK 4115	-	Hammersmith	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4116	-	Hammersmith	NHM	C	Calotte	Main channel	Probably dredged	Yes	-
SK 4119	-	Pimlico	NHM	F	Cranium	Associated deposits	Unknown	Yes	-
SK 4120	-	Wandsworth	NHM	D	Calvarium	Main channel	Probably dredged	Yes	-
SK 4121	-	Wandsworth	NHM	D	Calotte	Main channel	Probably dredged	Yes	-
SK 4122	-	Wandsworth	NHM	D	Calotte	Main channel	Probably dredged	Yes	-
SK 4123	-	Wandsworth	NHM	D	Calotte	Main channel	Probably dredged	Yes	-
SK 4124	-	Wandsworth	NHM	D	Calotte	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 4128	-	Putney	NHM	D	Calotte	Main channel	Probably dredged	Yes	-
SK 4129	-	Putney	NHM	D	Cranial fragment	Main channel	Probably dredged	Yes	-
SK 4130	-	Robiamors Dry Dock	NHM	G	Cranium	Associated deposits	Unknown	Yes	-
SK 4136	-	Westminster	NHM	F	Calotte	Associated deposits	Construction work	Yes	-
SK 4137	-	Deptford	NHM	G	Calvarium	Associated deposits	Unknown	Yes	-
SK 4138	-	Chelsea	NHM	E	Calotte	Main channel	Dredged	Yes	-
SK 4140	-	Richmond	NHM	B	Calotte	Main channel	Probably dredged	Yes	-
SK 4142	-	Isleworth	NHM	B	Calotte	Main channel	Dredged	Yes	-
SK 4148	-	Brentford	NHM	B	Calvarium	Main channel	Probably dredged	Yes	-
SK 4158	-	Thames	NHM	T	Calvarium	Main channel	Probably dredged	Yes	-
SK 4161	UNREG #13	Northfleet	NHM	H	Calvarium	Main channel	Dredged	Yes	-
SK 4162	UNREG #12	Northfleet	NHM	H	Calvarium	Main channel	Dredged	Yes	-
SK 4163	-	Thames	NHM	T	Calotte	Main channel	Probably dredged	Yes	-

SK ID	ALT ID	Location	Repository	Zone	Element	Deposit	Recovery	Osteo data?	Note
SK 4164	-	Mortlake	NHM	C	Cranial fragment	Main channel	Probably dredged	Yes	-
SK 4166	-	Westminster	NHM	F	Cranium	Main channel	Probably dredged	Yes	-
SK 4167	-	Battersea	NHM	E	Calvarium	Main channel	Probably dredged	Yes	-
SK 4168	UNREG #9/BAT-2	Battersea	NHM	E	Calotte	Main channel	Probably dredged	Yes	-
SK 4170	-	Westminster	NHM	F	Calvarium	Associated deposits	Unknown	Yes	-
SK 4175	-	Staines	NHM	A	Calotte	Main channel	Dredged	Yes	-
SK 4178	-	Greenwich	NHM	G	Articulated skeleton	Associated deposits	Unknown	Yes	-
SK 4179	-	Waterloo Bridge	NHM	F	Mandible	Associated deposits	Construction work	Yes	-
Yabsley 1*	-	Yabsley Street	MOL	G	Articulated skeleton	Former foreshore	Arch' excavation	No	-

4.1.2 The Maynard Reservoir assemblage

The Maynard Reservoir assemblage consists of a small group of human skeletal remains curated at the Natural History Museum, which were recovered during reservoir construction along the course of the River Lea at Walthamstow in the late 1860s. The assemblage is being examined alongside the Thames remains, in order to provide additional context for interpreting prehistoric water deposition in the main River Thames: the River Lea being a River Thames tributary. The catalogue for the Maynard Reservoir assemblage is given in Table 4.2 and a full overview of the assemblage is given in Section 5.2.

SK ID	Alt ID	Repository	Element
SK 4191A	1957.20.9.3; 41427	NHM	Mandible
SK 4191	1957.20.9.3; 41419	NHM	Cranium
SK 3311	1957.20.9.1; 41417	NHM	Cranium
SK 3311A	1957.20.9.1; 41427	NHM	Mandible
SK 4193	1957.20.9.5; 41421	NHM	Calvarium
SK 3310	1957.20.9.2	NHM	Atlas + 3rd cervical vertebra
SK 4198	1957.20.9.10; 41469	NHM	Skull
SK 4192	1957.20.9.4; 41420	NHM	Skull
SK 4195	1957.20.9.7; 41423	NHM	Frontal
SK 4196	1957.20.9.8; 41424	NHM	Frontal
SK 4194	1957.20.9.6; 41422; 41425	NHM	Frontal + Left parietal
SK 4185	1957.20.9.2; 41427	NHM	Mandible
SK 4188	1957.20.9.2; 41427	NHM	Mandible
SK 4189	1957.20.9.2; 41427	NHM	Mandible
SK 4187	1957.20.9.2; 41427	NHM	Mandible
SK 4186	1957.20.9.2; 41427	NHM	Mandible
UNREG 8651 (Waltham 1)	1957.20.9.2; 41184	NHM	Mandible
UNREG 8651 (Waltham 2)	1957.20.9.2; 41184	NHM	Left parietal
SK 4190 + 4197	1957.20.9.9; 41418 (SK 4197) 1957.20.9.2; 41427 (SK 4190)	NHM	Skull (mandible SK 4190 + cranium SK 4197)
SK 4200A	1957.20.9.11; 41429	NHM	Humeral pair
SK 4200B	1957.20.9.11; 41430	NHM	Left radius
UNREG Waltham 3	1957.20.9.11; 41431	NHM	Left femur
SK 4199A	1957.20.9.11; 41429	NHM	Left humerus
SK 4199B	1957.20.9.11; 41429	NHM	Right humerus
SK 4199C	1957.20.9.11	NHM	Left radius
SK 4201A	1957.20.9.11; 41429	NHM	Left humerus
SK 4201B	1957.20.9.11; 41432	NHM	Left fibula
SK 4201C	1957.20.9.11; 41428	NHM	Left scapula
SK 4201D	1957.20.9.11; 41433	NHM	Left inominate
SK 4201E	1957.20.9.11; 41426	NHM	Atlas
SK 4201F	1957.20.9.11	NHM	1st rib
SK 4201G	1957.20.9.11	NHM	2nd rib
SK 4201H	1957.20.9.11	NHM	Lower rib

Table 4.2: The Maynard Reservoir assemblage catalogue. “SK ID” is the unique skeletal identifier used in this thesis. SK IDs for all elements are prefixed with "NHMUK PA”. “ALT ID” provides any alternative ID numbers which have previously been used. “Repository” is the institution where the remains are currently curated. “NHM” is the Natural History Museum, London. “Element” is as defined in Section 4.3.2.

4.2 Temporal data

4.2.1 The new radiocarbon dating programme

4.2.1.1 Sample selection

The selection of individuals for radiocarbon dating was limited to material curated at the Natural History Museum. Thirty-two new radiocarbon dates were provided, and material was selected for inclusion according to two main criteria:

1) Geographic location

Individuals were selected on the basis of their geographic recovery location in order to allow for examination of spatial patterning in temporal data. Firstly, individuals were selected to build meaningful sample sizes of radiocarbon dated individuals at discrete locations. Mortlake, Kew, and Battersea were targeted, as these were known to already have multiple radiocarbon dated individuals from the three previous projects on the human remains from the River Thames (Bradley and Gordon, 1988; Edwards et al., 2009; Schulting and Bradley, 2013). Secondly, individuals were also selected to expand the existing geographical range of the radiocarbon dated sample (previously limited to the Kew to Battersea stretch of the Thames), in order to build a more holistic picture of deposition along the river.

2) Assemblage variation

Within these geographic locations, individuals were selected to ensure that the overall dated sample better represents the taphonomic and osteological variation present in the dataset. It was considered that associated radiocarbon dates would allow for more meaningful examination of several of the research aims (see Section 1.2). The characteristics focused on were: skeletal element (e.g., ensuring the inclusion of mandibular remains), age-at-death, osteological sex, those with potential trauma, and a range of gross taphonomic appearances. Sample selection was undertaken prior to osteological data collection, so these characteristics were assessed as best as possible from the documentation associated with a collections digitisation project previously undertaken on the human remains from the River Thames curated at the Natural History Museum.

In addition, two individuals which were dated by Bradley and Gordon in 1988 (SK 4062, SK 1507), prior to the introduction of ultrafiltration (which removes lower molecular weight contaminants), were re-dated to check for consistency. The cranium of the Maynard Reservoir individual SK 4191 was also dated. This individual was thought to have been dated as part of the Schulting and Bradley (2013) project. However, upon visual inspection it was apparent that the previously dated element was a mandible (SK 4191A), which did not rematch to the cranium with confidence. An independent date for the cranium (SK 4191) was generated, owing to the potential significance of a large perimortem blunt force injury on the cranium.

4.2.1.2 Sample preparation

The sample preparation methodology outlined here also applies to the isotopic analysis (Section 4.6.4): a single bone sample was taken from, and prepared for, each individual in the radiocarbon dating and isotopic subsamples (see Section 4.6.2 for details on the isotopic sample), and the resultant collagen product was then either used for both the radiocarbon dating and isotopic analysis (32 individuals in both the new radiocarbon dating and isotopic subsamples, see Sections 4.2.1.1 and 4.6.2), or solely the isotopic analysis (10 individuals with pre-existing radiocarbon dates).

Sampling of the remains was undertaken by the author at the Natural History Museum. A bone chunk, approximately 600-800 mg in weight, was taken from each individual using a circular diamond-coated cutting disk, attached to a variable speed rotary tool. This sample weight was required to provide the requisite collagen for use in the radiocarbon, $\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ analyses. At the time of sampling, larger amounts of collagen (around 10-15 mg) were necessary for sulphur isotope analysis due to analytical constraints associated with the low concentration of sulphur in mammalian bone collagen (Sayle et al., 2019:1259). Owing to the nature of the remains (i.e., most are crania), the majority of samples were taken from the cranial base, or mandible. The sampling location for each individual is given in Appendix A and C. Anatomical landmarks and pathological areas of bone were avoided, in line with NHM destructive sampling protocal. An example of a sampled bone element is given in Figure 4.1.

Figure 4.1: Inferior view of cranium UNREG 1414 recovered from Battersea, with the sampled area indicated (black arrow). © The Trustees of the Natural History Museum, London.

Sample preparation was undertaken by the author at the UCL Institute of Archaeology Stable Isotope Laboratory, following a modified Longin protocol (Longin, 1971). The surfaces of all samples were cleaned via sandblasting. Six samples (SKs 4055, 4062, 4067, 4073, 4119, 4191) were identified as potentially having been treated with an unknown conservation agent. These samples were subjected to a solvent wash step in order to remove this, following the method outlined in Brock et al., (2010). Then, following the method of Bronk Ramsey et al., (2004), all bone samples were demineralised in a dilute 0.5 M hydrochloric acid solution over three weeks, and then rinsed three times in deionised water. A base and acid wash step was conducted to remove humic contaminants: the samples were submerged in a 0.1 M NaOH solution for 30 minutes, rinsed three times in deionised water, then submerged in a 0.5 M HCL solution for an hour, and rinsed three times in deionised water. Next, the samples were gelatinised by heating in a pH3 aqueous solution at 75°C for 24-48 hours. The resulting solution was filtered using clean Ezee filters, before being ultra-filtered in order to remove lower molecular weight proteins (<30kD) and isolate the high molecular weight fraction. The resulting supernatant was then freeze-dried to produce the final collagen product.

4.2.1.3 Radiocarbon measurement

The prepared collagen was sent to the University of Groningen Centre for Stable Isotope Research in the Netherlands for radiocarbon measurement.

Calibrated date ranges in calendar years (95% confidence level) were calculated from the conventional radiocarbon measurements (years BP) using the IntCAL20 atmospheric calibration curve (Reimer et al., 2020) and OxCAL v4.4.1 (Bronk Ramsey, 2009). The calibrated date ranges are quoted with the end points rounded outwards to five years, following the recommendations of Mook (1986) and Bayliss et al. (2008).

4.2.2 Generating the overall temporal dataset

The overall temporal dataset was created to provide the most comprehensive chronological framework for the human remains from the River Thames to-date. The new radiocarbon dates (see Section 4.2.1) were combined with all human remains recovered from the River Thames and its associated deposits which have been dated externally to the current project. A literature review identified those which had been published in academic literature (e.g., Bradley and Gordon, 1988; Edwards et al., 2009; Schulting and Bradley, 2013) and grey literature. A period of active enquiry among the River Thames archaeological community identified several human remains which have been recovered in recent years as foreshore surface finds and radiocarbon dated via London's police forces, but had not yet been published or considered in academic discourse.

Single radiocarbon dates generated externally to the current project have been recalibrated where possible using the IntCAL20 atmospheric calibration curve (Reimer et al., 2020) and OxCAL v4.4.1 (Bronk Ramsey, 2009). This has been conducted to achieve better comparability between the newly-generated radiocarbon dates, and those published previously and calibrated using older calibration curves. The calibrated date ranges are quoted at the 95% confidence level. Following the recommendations of Mook (1986) and Bayliss et al. (2008), the end points of the calibrated date ranges have been rounded outwards to five years, unless the error is greater than ±25 years in which case they have been rounded out to ten years.

4.3 Taphonomic histories

4.3.1 Introduction

Taphonomy can be defined as the study of the “physical and chemical processes (induced by human, animal, or natural agents) that modify an organism after its death and through which it is incorporated into geological deposits” (LaMotta and Shiffer, 2005:122). For the purposes of this study, the term “taphonomic history” refers to the period of time between the point of death and the recovery of the remains. Taphonomy covers a broad range of processes (e.g., burning, trampling, butchery) (e.g., Pokines, 2013) but the focus of this study is to provide a broad overview of the taphonomic histories of the assemblages, and also to focus specifically on the question of exposure to fluvial environments.

4.3.2 Skeletal element representation, completeness, and MNI

As described in Section 4.1.1.2.3, each occurrence of human remains was assigned an element type (either single skeletal element, articulated elements, or articulated skeleton).

Each single skeletal element was further classified according to bone type (e.g., mandible, femur etc). In order to provide a ready measure of completeness, cranial remains were classified either as a cranium, calvarium, calotte, or cranial fragment, according to the following criteria, which are based on White et al., (2012:51):

- **Cranium:** no mandible, but some facial bones were present. If nasals were the only facial bones retained, assigned as calvarium.

- **Calvarium:** no facial bones were present (with exception of nasal bones), but cranial base bones were intact. Assigned if any of the cranial base bones were present.

- **Calotte:** no cranial base bones were present, but at least two articulated cranial vault bones present.

- **Cranial fragment:** a single cranial bone.

To provide a more rigorous measure of the completeness of each element, each individual bone comprising the element (i.e., single skeletal element, articulated elements, articulated skeleton) was recorded and given a completeness score. Completeness scoring followed Buikstra and Ubelaker (1994): 1= >75% present, 2= 25-75% present, 3= <25% present. This assessment was only conducted for the osteological portion of the assemblages (See Sections 4.1.1.1 and 5.1.1).

The minimum number of individuals (MNI) was estimated for the Maynard Reservoir assemblage. This was conducted as the assemblage is strongly suspected to have been recovered from a single, fairly restricted geographical location (see Section 5.2). The MNI was calculated by counting the most frequently-occurring bone. A separate MNI was provided for adult and subadult remains. More complex methodologies do exist for the calculation of MNI, such as the zonal method (Knüsel and Outram, 2004) which calculates MNI based on the presence of re-occurring bone features. However, it was not necessary to apply such methodologies to the Maynard Reservoir assemblage as there was very little fragmentation: individual elements were all very complete, and no potentially re-fitting bone fragments were present.

4.3.3 Taphonomic alterations to the bone surface

Taphonomic changes were recorded for the osteological portion of the assemblages. Data on a range of commonly-recorded general taphonomic changes were recorded (Section 4.3.3.2), as well as taphonomic changes specific to bones recovered from fluvial environments (Section 4.3.3.1). All bone elements were examined macroscopically for the following changes.

4.3.3.1 Fluvial transport

The identification of fluvially-derived bone assemblages is generally acknowledged to be problematic, owing to a variety of factors including a tendency for studies to have small sample sizes and poorly-reported experimental conditions (Evans, 2014). Many existing methods rely on the analysis of skeletal assemblages in relation to their find context: e.g., Voorhies groups (Voorhies, 1969), equivalent particle diameters (Behrensmeyer, 1975). In addition to being of debated utility in forensic settings (Evans, 2014), such methods are not appropriate to apply to the River Thames assemblage, owing to the lack of secure archaeological context for

the remains and the potential influence of recovery biases (e.g., see Chapter 5 and Chapter 6, Section 6.3.2.1.2).

However, exposure to fluvial environments has been observed to cause a wide range of modifications to bony elements themselves (Nawrocki et al., 1997; Haglund and Sorg, 2002; Evans, 2014). Standardised methodologies have not yet been developed for recording fluvial changes in skeletal remains, and some are not specific to fluvial environments. As such, identification of fluvial taphonomic changes in this thesis focused on several key, readily-observable macroscopic modifications. Such an approach was adopted to provide a general indication of the likelihood that the assemblages were exposed to fluvial forces, and potentially also transported by them, at some point in their depositional histories.

4.3.3.1.1 Abrasion

The majority of reported fluvial changes are abrasive in nature, and can operate both through the exposure of bone to particles suspended in moving water, as well as through the movement of bones themselves within the fluvial system (Haglund and Sorg, 2002). Crania may be particularly susceptible to these abrasive changes, as they are liable to move via rolling along the bottom of riverbeds (Haglund, 1993; Nawrocki et al., 1997; Haglund and Sorg, 2002). A wide range of abrasive changes are reported in the literature in relation to fluvial environments: e.g., pitting, scratching, gouging, denting, notches, perforation of thin plates of bone, enlargement of openings, chipping of anterior dentition etc (Nawrocki et al., 1997; Haglund and Sorg, 2002; Evans, 2014). For the aforementioned reasons relating to lack of available recording methodologies and non-specific nature of some of these changes (e.g., pitting of bone could also occur through chemical dissolution), a single measure of general bone surface abrasion was recorded in this study, according to the system of McKinley (2004). This system also has the advantages of being well-defined and widely-applied in osteological studies, the later meaning comparisons are possible with other skeletal assemblages. Each bone element was given an abrasion grade, from 0-5+, based on the criteria outlined in Table 4.3.

Polishing of the bone surface was also recorded, as this is readily-observable across all bone elements and a distinctive abrasive change. Bone surface polishing was recorded for each skeletal element as either present, absent, or unobservable.

Abrasion grade	Description
Grade 0	Surface morphology clearly visible with fresh appearance to bone and no modifications.
Grade 1	Slight and patchy surface erosion.
Grade 2	More extensive surface erosion (by root action) than grade 1 with deeper surface penetration.
Grade 3	Most of bone surface affected by some degree of erosion; general morphology maintained but detail of parts of surface masked by erosive action.
Grade 4	All of bone surface affected by erosive action; general profile maintained and depth of modification not uniform across whole surface.
Grade 5	Heavy erosion across whole surface, completely masking normal surface morphology, with some modification of profile.
Grade 5+	As grade 5 but with extensive penetrating erosion resulting in modification of profile.

Table 4.3: The McKinley (2004) abrasion grades.

4.3.3.1.2 Loss of facial bones

Human crania recovered from riverine environments often present destruction and loss of the facial bones (Nawrocki et al., 1997). The facial bones are the least robust of the cranial bones, are can be damaged when crania roll along the bottom of the riverbed during transport (Nawrocki et al., 1997). In this study, loss of facial bones was accessed through the broad designation of cranial remains as either: crania, calvaria, or calottes (see Section 4.3.2).

4.3.3.1.3 Sediment impaction

The impaction of riverine matrix, such as sediment or small stones, within small cracks and openings in bones is a commonly-observed fluvial modification (Nawrocki et al., 1997; Evans, 2014). Sediment impaction was recorded in this study as among all the indicators it is perhaps the most indicative of exposure to a fluvial environment: there are few processes operating in standing bodies of water which could produce such an effect (Evans, 2014). Sediment impaction was recorded for each skeletal element as either present, absent, or unobservable (e.g., where there were no small cracks or openings on the bone surfaces).

4.3.3.2 General taphonomic changes

A wide range of taphonomic changes to bone are identified in the literature, relating to various chemical, biological, and physical aspects of the depositional environment. This study focused on recording a limited range of general taphonomic changes: subaerial weathering, staining, and terrestrial animal modification. These changes were selected as they had the potential to reveal key information about the depositional environments the remains were exposed to (e.g., if they were subject to periods of subaerial exposure), could be readily identified and recorded at the macroscopic level, and were expected to be recordable in a high proportion of the overall assemblage. They are also widely recorded in osteological analyses (for example, they are among the taphonomic changes recommended for recording in Buikstra and Ubelaker 1994, Standards for Data Collection from Human Skeletal Remains), which means that methods for their recording are well-defined and comparative data are available. The presence of perimortem cut marks is considered along with evidence for violence-related trauma (Chapter 7). The general taphonomic changes and the specific methodologies used to record them are outlined below.

4.3.3.2.1 Subaerial weathering

Subaerial weathering causes distinctive modifications to bone surfaces: bone bleaches, cracks, and flakes owing to exposure to solar radiation, temperature fluctuations, precipitation, and chemical processes (Junod and Pokines, 2014:287).

Subaerial weathering was recorded following the Behrensmeyer (1978) system, which is outlined in Table 4.4. A weathering stage (0-5) was assigned to each bone element.

The Behrensmeyer (1978) method was developed through observations of bone changes in a savannah environment in equatorial Africa. There are a limited number of experimental studies which have applied this method in British contexts, and these have indicated that the rate of subaerial weathering is slower in this more temperate climate. For example, Andrews and Cook (1985) did not observe any progression beyond Stage 0 (no weathering, see Table 4.4) in a cow carcass subaerialy exposed for seven and a half years. Andrews and Armour-Chelu (1998), studying an assemblage of sheep bones which had been exposed for up to 18

years, found the majority of bones (62.5%) remained at Stage 0, and that none had progressed to Stage 5 (the final stage, see Table 4.4).

However, although a range of different variables (including climatic variables such as temperature and moisture) can affect the rate of weathering, the changes have been demonstrated to progress in a consistent pattern across different environments (Behrensmeyer, 1978; Ross and Cunningham, 2010; Madgwick and Mulville, 2012; Junod and Pokines, 2014), and the Behrensmeyer (1978) method has been applied with good effect to examine the depositional histories of archaeological bone assemblages from British contexts (e.g., Madgwick, 2008; Waddington, 2008; Walsh et al., 2011; Madgwick and Mulville, 2012). It is currently the most widely- used, and one of the only methods available (e.g., see Junod and Pokines, 2014), for the macroscopic recording of subaerial weathering.

As in many osetoarchaeological studies (e.g., Madgwick, 2008; Waddington, 2008; Walsh et al., 2011; Madgwick and Mulville, 2012; Mollerup et al., 2016), subaerial weathering is examined in this study to consider if, during their depositional histories, any elements experienced a period of surface exposure and could therefore potentially represent mortuary practices involving excarnation, and/or disturbed burials. However, it is important to acknowledge that, partly owing to the slower rate of subaerial weathering in temperate British environments, the absence of these changes on elements does not preclude them having undergone such processes. Subearial weathering is not examined here with the intention of estimating the post-mortem exposure interval although, along with other indicators, it is often examined with this aim in forensic anthropology (Junod and Pokines, 2014:301) and also in some osteoarchaeological studies (e.g., Mollerup et al., 2016).

Weathering Stage	Description
Stage 0	Bone surface shows no sign of cracking or flaking due to weathering.
Stage 1	Bone shows cracking, normally parallel to the fibre structure (e.g. longitudinal in long bones). Articular surfaces may show mosaic cracking.
Stage 2	Outermost concentric thin layers of bone show flaking, usually associated with cracks, in that the bone edges along the cracks tend to separate and flake first. Long thin flakes, with one or more sides still attached to the bone, are common in the initial part of this stage. Deeper and more extensive flaking follows until the outermost bone is gone. Crack edges are usually angular in cross section.
Stage 3	Bone structure is characterized by patches of rough, homogeneously weathered compact bone resulting in a fibrous texture. In these patches, all the external, concentric layers of bone have been removed. Gradually, the patches extend to cover the entire bone surface. Weathering does not penetrate deeper than 1.0–1.5mm at this stage, and bone fibres are still firmly attached to each other. Crack edges are usually rounded in cross section.
Stage 4	The bone surface is coarsely fibrous and rough in texture; large and small splinters occur and may be loose enough to fall away from the bone if it is moved. Weathering penetrates into inner cavities. Cracks are open and have splintered or rounded edges.
Stage 5	Bone is falling apart, with large splinters. Bone is easily broken by moving. Original bone shape may be difficult to determine. Cancellous bone is usually exposed when present and may outlast all traces of the former more compact, outer parts of bone.

Table 4.4: The Behrensmeyer (1978) weathering stages.

4.3.3.2.2 Staining

Bone can become stained postmortem through exposure to a variety of causative agents such as heat, sun bleaching, soil, or contact with metal objects (Dupras and Schultz, 2013).

Staining was recorded at two levels. Generalised staining was recorded via identification of the dominant colour of the bone surface of each element. A Munsell© soil colour chart was used to assign a colour score and description (e.g., 7.5YR 3/2, “Dark brown”) to each element. This approach provides a more objective measure of colouration and is a widely-used methodology for recording the colour of bone in taphonomic studies of human remains (Buikstra and Ubelaker, 1994; Dupras and Schultz, 2013). If the element presented more than one colour, only the dominant colour was recorded. If the colour of the bone surface was not observable (e.g., owing to the presence of overlying concretions), colour was recorded as “unobservable”. Localised areas of staining were also recorded. The approximate level of coverage (i.e., less than 10% of bone surface, or greater than 10%) and the colour of the staining were recorded.

4.3.3.2.3 Terrestrial animal modification

The presence of tooth marks on the bone surface arising from terrestrial animal activity were recorded, where these could be identified with confidence. Damage associated with rodents and carnivores formed the focus, as they are among the most commonly-encoutered forms of modification (Stodder, 2018:87) and were expected to be the most relevant to these assemblages given the geographical and temporal context. Similarly to subaerial weathering (Section 4.3.3.2.1), these changes were recorded with the aim of considering whether any elements experienced a period of surface exposure during their depositional histories. Modifications were identified and categorised through reference to the relevant taphonomic literature (e.g., Haynes, 1980; Binford, 1981; Haglund et al., 1988; Pokines, 2014).

Rodent gnawing marks were identified through reference to Pokines (2014). Rodents may gnaw both fresh bone and dry bone (Pokines, 2014). Both modes have morphological commonalities, most notably the production of fine parallel grooves with uniform pitch, though there are also several differences (Pokines, 2014). For example, soft tissues are consumed during fresh bone gnawing and bone damage tends to be concentrated on delicate areas (e.g., epiphyses, nasal margins, orbital margins), whereas dry bone gnawing tends to be concentrated on sharp margins of dense bone (e.g., long bones where the epiphyses have been removed by other processes) (Pokines, 2014). Although similar in overall morphology, larger

rodents (e.g., porcupines) produce broader, flatter, and deeper marks than smaller rodents (e.g., rats) (Pokines, 2014).

Four types of carnivore tooth mark are widely recognised in the taphonomic literature: pits, punctures, scoring, and furrows. These are described below, alongside the criteria used to identify them on elements (compilled from Haynes, 1980; Binford, 1981; Haglund et al., 1988; Pokines, 2014).

- **Pits**: identations caused by the tips of teeth which occur when the animal bites down, but there is insufficient strength to completely penetrate the cortex. Creates circular or irregular depressions in the cortical bone, which do not extend to the bone interior, and have a maximum length no more than three times their maximum width.

- **Punctures**: marks caused by the collapse of the bone under a tooth. These are deeper depressions than pits, which fully penetrate the cortical bone. The margins tend to be broken/crushed in. These most often appear as perforations in thin areas of bone (e.g., scapula, cancellous ends of long bones).

- **Scoring**: marks produced when teeth slip and drag over cortical bone. These are linear, often parallel, scratches of the same penetrative form as pits, but three times or more longer in maximum diameter than width. Scores may appear at most places on the bone, as they are often formed where a bone was gripped for transport or repositioning. Scoring generally follows the contour of the bone.

- **Furrows:** channels in bone produced by the cusps of cheek teeth, which extend from the ends of long bones longitudinally into the marrow cavity. These marks are of the same penetrative form as punctures, but three times or more longer in maximum diameter than width.

Numerous carnivore taxa are capable of producing such damage (e.g., felids, ursids, and canids such as dogs, wolves, and foxes) and it is difficult to identify which may be responsible on the basis of the marks alone, although tooth punctures may preserve the shape of the tooth which caused them (Pokines, 2014:210, 223).

Contra to rodents, carnivores generally avoid dry or weathered bone without attached soft tissues, as it lacks nutrients (Pokines, 2014:222).

4.4 Demography

4.4.1 Introduction to demography

The demographic profile (i.e., the age-at-death and sex distribution) of a skeletal assemblage can provide clues as to the processes which were involved in its formation. For example, deviation in an assemblage's demographic profile from that which would be expected under conditions of normal, attritional mortality (i.e., high juvenile mortality, steadily increasing numbers of adults with increasing age, approximately equal proportions of males and females (Chamberlain, 2006)), could indicate cultural practices whereby certain individuals are given a particular funerary treatment on the basis of aspects of their social identity constructed around biological sex and age (e.g., Bello and Andrews, 2006; O'Regan et al., 2020). Alternatively, deviations from attritional mortality profiles could reflect other processes, such as episodes of conflict (e.g., Redfern and Chamberlain, 2011; Brinker et al., 2013), or disease (Gowland and Chamberlain, 2005; DeWitte, 2010). In addition to these cultural factors, various taphonomic and methodological factors may bias the demographic structure of a skeletal assemblage, and must be considered when interpreting such data.

The interpretations which can be drawn from the demographic profile of the River Thames assemblage are slightly limited by the fact that the assemblage does not represent a population as usually defined in demographic studies, owing to the temporal and spatial diversity in the origins of the remains. However, these issues are mitigated to an extent by considering the patterns with regard to chronology.

4.4.2 Age-at-death

Age-at-death was estimated for each single skeletal element, partially-articulated element, or articulated skeleton, using a range of widely-applied osteological methods. Methods were not applied where pathological conditions were observed which may affect the appearance of specific age-at-death indicators (e.g., scaphocephaly).

For adults, the age-at-death estimation methods applied were: auricular surface morphology (Lovejoy et al., 1985), pubic symphysis morphology (Brooks and Suchey, 1990), dental attrition (Brothwell, 1981), ectocranial suture closure (Meindl and Lovejoy, 1985), and endocranial suture closure (Acsádi and Nemeskéri, 1970). Third molar eruption and the late fusing epiphyses (the medial clavicle, and the iliac crest) were also examined where possible, as they have the potential to indicate young adult status (Scheuer and Black, 2000; Liversidge and Marsden, 2010).

Cranial suture closure methods are considered to be one of the least reliable for adult age-at-death estimation (Buikstra and Ubelaker, 1994:36; O'Connell, 2004, 2017). Although cranial sutures generally fuse with increasing age, there is considerable variability in closure rates between individuals owing to a variety of factors (e.g., hormonal factors, diet), although these are poorly understood (Cox, 2000:68; Ruengdit et al., 2020). Tests of cranial suture closure methods using known age skeletal collections reflect this, and have reported wide ranges of inaccurary in terms of the difference between estimated and actual ages (e.g., Molleson and Cox, 1993; Key et al., 1994; Herchovitz et al., 1997; Wolf et al., 2012; Ruengdit et al., 2018). A review of published studies by Ruengdit et al., (2020) reported overall inaccuracy ranges between 0.6 and 26.2 years for the Acsádi and Nemeskéri (1970) method and between 2.5 and 45.6 years for the Meindl and Lovejoy (1985) method.

However, cranial suture closure methods are still widely used (see review by Garvin and Passalacqua, 2012) and, in general, deemed able to provide broad estimations of age-at-death (e.g., "younger adult", "middle adult", "older adult") (e.g., Key et al., 1994; O'Connell, 2004; Falys and Lewis, 2011:713; Wolff et al., 2012; Ruengdit et al., 2020). For example, in their study of known-age Hungarian skeletal remains, Wolff et al., (2012) found that the Acsádi and Nemeskéri (1970) endocranial suture closure method was suitable for the provision of a rough estimate of age-at-death in 72.25% of 238 individuals examined. Cranial suture closure methods are also of particular utility when other skeletal indicators of age are not available (Cunha et al., 2009; Ruengdit et al., 2020:8). This is the spirit in which they were used in this study. Cranial suture closure is one of the only methods which can be applied to crania lacking in dentition, and such remains comprise 64.6% (153/237) of the River Thames assemblage (see Figure 6.6). The age-at-death categories applied in this study (see Table 4.5) are also broad, in part to reflect the higher degree of uncertainty introduced through the application of cranial suture closure methods.

The Acsádi and Nemeskéri (1970) endocranial suture closure method is not as routinely used in osteological studies as the Meindl and Lovejoy (1985) method (Garvin and Passalacqua, 2012). However, it was utilised here as it can be applied to less complete cranial remains than required for the ectocranial method (Meindl and Lovejoy, 1985) and also as taphonomic changes often obscured the appearance of the ectocranial sutures, while the endocranial surfaces were less affected. Endocranial sutures have also been argued to have a closer association with chronological age than ectocranial sutures (Key et al., 1994; Galera et al., 1998; Wolff et al., 2012; Ruengdit et al., 2020:6).

For subadults, the methods used to determine age-at-death were the stages of epiphyseal fusion (Scheuer and Black, 2000), dental eruption (Gustafson and Koch, 1974), and dental development (Moorrees et al., 1963).

Each individual was assigned an age-at-death category, outlined in Table 4.5, on the basis of the above methods, using a best fit approach. The categories are based on those used in the standards published by the Museum of London (Powers, 2012), developed for skeletal recording on to their Wellcome Osteological Research Database (WORD). However, the categories used in this thesis are broader, with only two subadult age categories, and three adult categories which effectively form ordinal categories (i.e., 18-25 years (young adult), 26-45 years (middle-aged adult), 46+ years (older adult)). Particularly for the adults, it was deemed necessary to use these broader categories to reflect the higher degree of uncertainty in the age estimations which could be generated for the River Thames and Maynard Reservoir assemblages: the general incompleteness of the remains (see Sections 6.3.1.1 and 6.4.1.1) meant that in most cases only one or two age estimation methods could be applied, and included cranial suture closure (which, as aforementioned, is not considered to be a particularly reliable indicator of age-at-death). The use of such broad adult age-at-death categories is often recommended, and particularly for assemblages with high levels of incompleteness (e.g., Buikstra and Ubelaker, 1994; O'Connell, 2004; Falys and Lewis, 2011:712). For subadults, it was also deemed appropriate to use broader categories owing to the low number of subadults in the River Thames assemblage (see Section 7.1).

In instances of discrepancy in the age estimation of an individual produced by different methods, less weight was given to cranial suture closure data. General

adult (>18 years) and subadult (<18 years) categories were assigned when a more specific age-at-death estimation could not be made on the basis of the above methods, due to a lack of observable features, but general age-at-death was readily apparent (e.g., from the status of epiphyseal fusion, the presence of adult or subadult dentition, or the overall morphology). Age-at-death was given as "undetermined" in cases where there were insufficient observable features to assign even a broad age-at-death (e.g., a cranial fragment with no observable sutures).

Age-at-death categories were also assigned to the non-osteological group (see Sections 4.1.1.1 and 5.1.1). The categories were assigned to individuals on the basis of associated descriptions (e.g., in publications or skeletal report), or through visual inspection of photographs. No attempt was made to apply specific osteological ageing methods from photographs (e.g., scoring of cranial suture closure). Rather, individuals were placed into the appropriate age-at-death category based on readily observable features: i.e., the status of epiphyseal fusion, the presence of adult or subadult dentition, or general morphology (e.g., size, robustness).

Broad age group	**Age-at-death category**
Subadult	0-11 years
	12-17 years
	Subadult (<18 years)
Adult	18-25 years
	26-45 years
	46+ years
	Adult (>18 years)
Undetermined	Undetermined

Table 4.5: The age-at-death categories used in this thesis, grouped according to their corresponding broad age group.

4.4.3 Sex

An overall sex was assigned to each individual in the assemblages, either:

1) Female
2) Male

3) Undetermined
4) Not applicable (subadult)

This was determined for the majority of the dataset on the basis of osteological assessment by the author, using the methods outlined below in Section 4.4.3.1.

Genetic sex estimations were additionally available for 32 individuals, produced as part of separate aDNA projects for 28 crania from the Natural History Museum (Green et al., 2019), and four crania from the Museum of London (Booth, 2019). Where available, the genetic sex estimations were used over the osteological assessments, though the osteological data were recorded as well. The genetic sex estimations for these individuals can be found in Appendix B.

An overall sex was also assigned to individuals in the non-osteological group (see Sections 4.1.1.1 and 5.1.1), on the basis of associated documentation (e.g., publication, skeletal reports). No attempt was made to determine sex on the basis of photographs, owing to the fact that the osteological sex estimation methods require the scoring of subtle morphological changes which was not deemed appropriate to attempt from photographs. All remains for which only photographs exist were categorised as either "Undetermined", or "Not applicable (Subadult)".

4.4.3.1 Sex: osteological methods

For the adult remains, sex was estimated using a range of standard osteological methods which are based on observation of the sexually-dimorphic features of the skull and pelvis. Sex was not estimated for subadult remains (<18 years), owing to the lack of generally-accepted standard methods (e.g., Brickley and Buckberry, 2017). Cranial features were: the appearance of the supraorbital ridges, mastoid processes, nuchal crest, forehead slope (Bass, 1987), supra-orbital margin, and zygoma root (Ferembach et al., 1980). Mandibular features were: the mentum, gonial angle, gonial flare, ramus flexure, and ramus breadth (Bass, 1987). Pelvic features were: the ventral arc, medial portion of pubis (Phenice, 1969), greater sciatic notch, preauricular sulcus, subpubic angle, subpubic concavity, and median ischiopubic ridge (Bass, 1987).

Following the notation of the standards published by the Museum of London (Powers, 2012), each observable feature was scored on a five-point scale as either:

1 (male), 2 (probable male), 3 (intermediate), 4 (probable female), 5 (female). An osteological sex score (1-5, or undetermined), was assigned to each single skeletal element, partially-articulated elements, or articulated skeleton, from the composite of these scores. Undetermined sex was assigned when either no sex indicators were observable, only one was observable, or when two indicators were observable but not in general agreement. Where pelvic data were available this was prioritised, as it is the most sexually dimorphic area of the human skeleton and considered to be the most reliable area for sex estimation (Buikstra and Ubelaker, 1994:16; Christensen and Passalacqua, 2018:113; Harrison, 2019:26; Klales, 2020:75). Much of this sexual dimorphism is thought to relate to the functional role of the female pelvis in childbirth (Harrison, 2019:26; Klales, 2020:75).

Individuals with osteological scores of 1 (male) and 2 (probable male) were assigned an overall sex of “Male”, those with scores of 4 (probable female) and 5 (female) were assigned to the “Female” category, and those with scores of 3 (intermediate) or undetermined, were assigned to the overall sex category “Undetermined”.

4.5 Violence-related trauma

4.5.1 Introduction to violent trauma in bioarchaeology

Understandings of violence, particularly of what constitutes violence, are highly variable at different levels; for example, understandings can vary between cultures, but also at the individual level, where the meaning of violence could even change for an individual across their life course owing to the events and circumstances encountered (Redfern, 2017:3). Redfern (2017:4) suggests that the World Health Organization definition of violence may be the most useful for bioarchaeological research, as it excludes unintentional accidents and focuses on intention: defining violence as “the intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community, that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment, or deprivation” (WHO, 2002:5). It is clear from this definition that violence can include a range of behaviours across different scales, from domestic violence to inter-community warfare; the relationship between such micro and macro scales of violence is emphasised in the ecological model of violence (WHO, 2002:12-13) and the web of violence model (Turpin and Kurtz, 1997).

4.5.2 Identifying and recording violence-related trauma

Violence-related trauma was primarily identified in this thesis through the presence of skeletal trauma caused by weapons, as this is a widley-recognised skeletal indicator of intentional violence (Boylston, 2004; Krakowka, 2017:4; Loe, 2017; Torres-Rouff et al., 2018:6; Dittmar et al., 2019). However, it is acknowledged that the identification of violence from skeletal remains is not straightforward (e.g., Martin and Harrod, 2015; see Section 4.5.2.1) and, furthermore, that evidence from skeletal remains can only reflect part of the reality of violence in any given population (Redfern, 2017:9). Weapon trauma produces bone fractures, partial or complete breaks in the bone (Ortner and Putschar, 1981:55), with distinctive patterning. Trepanations were also recorded, as they are sometimes related to violence, albeit indirectly (see Section 4.5.2.2). Although other forms of skeletal trauma may be produced through violence, such as parry fractures and rib fractures, these do not form a focus in this thesis owing to their predicted low occurrence given the assemblage compositions (i.e., primarily cranial remains).

Throughout this text the term “trauma” is used to refer only to the aforementioned weapon trauma and trepanations, which may have been produced in (or related to, in the case of trepanations), violent contexts. Generally, the term trauma is more broadly defined in the osteological literature, e.g., as “any bodily injury or wound” (Roberts and Manchester, 2005:84), and includes fractures of pathological or other origin (e.g., Bennike, 2008).

Only the 223 individuals in the osteological dataset were included in the analysis of trauma (see Sections 4.1.1.1 and 5.1.1). All traumatic lesions were examined macroscopically, and using a hand lens when necessary. The traumatic lesions were recorded following generally accepted osteological standards (Buikstra and Ubelaker, 1994; Roberts, 2006; Loe, 2017), which included recording the fracture type (see Sections 4.5.2.1 and 4.5.2.2), timing (see Section 4.5.2.3), size, shape, orientation, location, and differential diagnoses where appropriate.

The location of the lesion was also recorded systematically at the level of the affected bone, to aid with the interpretation of injury patterning. If more than one bone was affected by a single lesion, then the bone which accounted for the largest proportion of the lesion was identified as the affected bone.

4.5.2.1 Weapon trauma

Weapon trauma was classified according to the likely causal force and mechanism after Spitz (1980) as: blunt force trauma, sharp force trauma, or projectile trauma. This approach is generally recommended for recording weapon trauma in skeletal remains (e.g., Boylston, 2000; Boylston, 2004; Loe, 2017), and is widely applied (e.g., Novak, 2000; King, 2010; Redfern, 2011; Krakowka, 2017; Dittmar et al., 2019; Tumler et al., 2019). All bones were examined for the presence of these lesions, which were identified according to the criteria outlined in Table 4.6. Examples of the different categories of weapon trauma are given in Figure 4.2. An "undetermined" category was added for instances where trauma was identified, but the exact mechanism was obscured due to taphonomic damage (e.g., the loss of associated areas of bone). It is difficult to definitively identify projectile trauma in the absence of an embedded projectile point (e.g., Redfern, 2009). However, this was hypothesised on the basis of the shape and size of the lesion, as projectile injuries are often "patterned" and mimic the shape of the causal weapon (Kimmerle and Baraybar, 2008; Forsom and Smith, 2017), in combination with the criteria outlined in Table 4.6. The differential diagnoses in the identified cases of projectile trauma are sharp or blunt force trauma, depending on the morphology of the lesion. Significant overlap may exist between the categories of weapon trauma. For example, heavy bladed weapons such as axes can produce traumatic injuries with a combination of sharp and blunt force characteristics (e.g., Kimmerle and Baraybar, 2008).

It is important to acknowledge that these lesions are not always directly indicative of violent intention, and close attention must be paid to their patterning and the wider archaeological context. For example, blunt force trauma can also arise through accidental falls and blows (Galloway and Wedel, 2014). In general, blunt force trauma which occurs in the area of the hat brim line is more likely to relate to accidental falls, whereas that located above it is more likely to relate to intentional blows (Kremer and Sauvageau, 2009). Sharp force trauma can sometimes relate to postmortem processing of the body as part of normative funerary rituals (e.g., Pérez, 2012).

Blunt Force Trauma	Sharp Force Trauma	Projectile Trauma
• Depressions on the outer table of bone	• Incision marks, often linear, with well-defined edges	• A depression, penetration, or perforation
• Inward displacement of the endocranial surface	• Smooth, flat, “polished” appearance to fracture margins	• Delamination at margins
• Radiating or concentric fractures	• Bone wastage at margins	• Internal bevelling of fracture edges
• Internal bevelling of fracture edges	• Hinge fractures	• Radiating or concentric fractures
• Adherence of inwardly-driven bone fragments	• Smaller parallel cut marks on margins	

Table 4.6: The criteria used for the identification of the different categories of weapon trauma. The criteria were compiled from Boylston (2000), Boylston (2004), Kimmerle and Baraybar (2008), Redfern (2009), Byers (2010), Passalacqua and Fenton (2012), Krakowka (2015), Forsom and Smith (2017). N.B., It is difficult to definitively identify projectile trauma in the absence of an embedded weapon owing to the morphological overlap with certain types of blunt force and sharp force injuries (e.g., Redfern, 2009). However, this was hypothesised based on the shape and size of the lesion as projectile injuries are often “patterned” and reflect the shape of the causal weapon (Kimmerle and Baraybar, 2008; Forsom and Smith, 2017), in combination with the listed criteria, particularly the presence of delamination at the fracture margins which is strongly associated with projectile trauma (Redfern, 2009; Passalacqua and Fenton, 2012; Forsom and Smith, 2017).

Figure 4.2: Examples of the different categories of weapon trauma, from the River Thames assemblage: blunt force trauma (left image), sharp force trauma (central image), and projectile trauma (right image). All examples are perimortem injuries, and the ectocranial view of the lesion is given.

4.5.2.2 Trepanation

Trepanation, the cutting, scraping or drilling of opening/s into the skull (Verano, 2017:2), is conducted for a variety of reasons across different time periods and geographical regions, but was recorded here as trepanations are sometimes connected to episodes of violent injury (e.g., Zimmerman et al., 1981). Their presence is the assemblage was also expected from the observations of previous studies (Edwards et al., 2009; Schulting and Bradley, 2013). In addition to the features outlined in Section 4.5.2, the method of trepanation was assessed when possible, the characteristics of the opening noted (e.g., striations or cut marks), and differential diagnoses were considered drawing on Verano (2017).

The most commonly reported methods of trepanation are: 1) scraping, where a sharp-edged oval implement is repeatedly scraped over an area of bone until the centre penetrates the skull; 2) grooving, where a circular or oval portion of bone is demarcated by repetitive cutting with a pointed instrument, until a disc of bone can be removed; 3) linear cutting, where a sharp-edged implement is used to produce intersecting cuts that define a rectangular area of bone which is removed; and 4) boring and cutting, where a circle of small holes are drilled and the bone bridges between them are then cut to allow the removal of a disc of bone (Lisowski, 1967; Aufderheide and Rodríguez-Martín, 1998:33; Verano, 2017:112).

4.5.2.3 Fracture timing

Assessing the timing of the fracture: whether it occurred in the antemortem period (before death), the perimortem period (at or around the time of death), or the postmortem period (after the time of death), is essential for interpretation. Fractures were classified as antemortem if signs of healing were present: e.g., bone remodelling, rounding of the edges of the wound (Barbian and Sledzik, 2008; Loe, 2017). Differentiation of perimortem trauma from postmortem taphonomic damage is possible because fresh, wet bone, responds differently to traumatic forces compared to dry bone which has lost its collagen and moisture content in the postmortem period (Galloway et al., 1999; Moraitis et al., 2008; Loe, 2017). Perimortem fractures were identified using the criteria listed below (compilled from Ubelaker and Adams, 1995; Sauer, 1998; Galloway et al., 1999; Moraitis et al., 2008; Byers, 2010; Loe, 2016). For a fracture to be classified as perimortem, a consistent taphonomic patina

had to be present, along with at least one other criterion appropriate for the particular fracture type.

- Consistent taphonomic patina with surrounding bone (e.g., colouration, presence of concretions)
- Sharp, smooth edges/walls
- Internal bevelling
- Delamination of fracture margin
- Presence of adhering bone fragments
- Presence of concentric or radiating fractures, which may follow path of least resistance e.g., terminate at points of weakness such as sutures or foramina

The actual period within which perimortem fractures may be produced is variable, and potentially fairly broad. For example, injuries may occur some time before the individual's death, but display no macroscopic signs of healing: it has been suggested that such changes may take at least a week, or as long as three weeks to appear, depending on a range of intrinsic and extrinsic variables (Loe, 2016:352). Bone may also respond to traumatic forces in a perimortem manner long after death owing to the retention of moisture and collagen content, which may vary according to the depositional context (Galloway et al., 1999; Loe, 2016:352; also see Section 4.5.2.4). For example, Maples (1999) suggested that the moisture content of bone could be retained for several weeks after death, and Wieberg and Westcott's (2008) study of porcine bones exposed to natural taphonomic conditions found that moisture content was retained and bones did not consistently fracture in a characteristically postmortem manner until almost five months after the death event.

Therefore, the presence of perimortem skeletal trauma does not necessarily mean that this was associated the individual's death. This is contrary to the usage of the term in forensic pathology, where perimortem injuries are understood to be those directly connected with the death event (Sauer, 1998; Passalacqua and Fenton, 2012:401-402).

4.5.2.4 Additional considerations for remains from fluvial environments

The appearance of some fracture characteristics may be obscured in remains from fluvial environments, owing to taphonomic alteration. For example, remains are

often incomplete, fracture edges may be distorted by abrasion, and any adhering bone fragments are likely to be lost. This may limit the confidence with which perimortem trauma can be distinguished from postmortem damage (e.g., Moraitis et al., 2008). Therefore in this study, high and mid probability categories were used to classify trauma, following recommendations of Loe (2017). The mid probability category was assigned in instances where perimortem trauma was strongly suspected, but taphonomic damage obscured some aspects of the fracture morphology.

Furthermore, distinguishing perimortem trauma from postmortem damage in skeletal remains from watery environments may be complicated by the fact that the interval during which bone responds to damage in a characteristically perimortem manner may be prolonged, as moisture is retained (Galloway et al., 1999; Kjellström and Hamilton, 2014). This could lead to postmortem damage being identified as perimortem trauma. The extent to which such a process may affect the assemblages is considered further in the discussion of the results in Chapter 7, Section 7.7.3.

4.5.2.5 Calculating trauma prevalence rates

Crude prevalence rates of trauma were calculated as the number of individuals with at least one traumatic injury, divided by the total number of individuals in the particular sample or subsample in question.

True prevalence rates of trauma were calculated for each major skull bone, as this data provides a better understanding of how the composition of the skeletal sample may have influenced the trauma patterning (Roberts, 2006). These were calculated by dividing the number of a particular element (e.g., frontal bone) affected by traumatic injury, by the total number of that element present in the overall sample (with a completeness score of 1 or more, see Section 4.3.2). If one discrete lesion affected multiple bones, the bone that presented with the largest percentage of the injury was considered to be the affected element.

4.6 Carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulphur ($\delta^{34}S$) stable isotope analysis

4.6.1 Introduction to the methods

4.6.1.1 General principles of stable isotope analysis

Stable isotope analysis of skeletal remains has been routinely conducted to examine diet in past populations since its first archaeological applications in the mid-1970s (Vogel and Van Der Merwe, 1977).

The ability to examine aspects of diet from the stable isotope values of body tissue is based on several principles. The first of these is that certain elements have naturally occurring stable isotopes. Isotopes are atoms of the same element which have the same number of protons, but different numbers of neutrons, and which therefore differ in their atomic mass. Stable isotopes do not decay with time. For example, carbon has three naturally occurring isotopes: ^{12}C and ^{13}C, which are stable, and ^{14}C which decays over time, hence its use in radiocarbon dating.

The second principle is that the relative abundance of some stable isotopes varies in different dietary resources, owing to isotopic fractionation (the chemical process through which the relative abundances of stable isotopes are altered). Fractionation can occur in various settings, including biological and geochemical cycles (Schoeller, 1999). For example, during photosynthesis, heavier isotopes (e.g., ^{13}C) react at a slower rate than lighter isotopes (e.g., ^{12}C), which causes plant matter to generally have much lower proportions of the heavier ^{13}C isotope compared to atmospheric values (e.g., O'Leary, 1981).

The third principle is that the isotopic values of body tissues have quantifiable relationships with the values present in the food consumed. For bone collagen, the tissue of interest in this study, the isotopic values of the amino acids are primarily related to the isotopic values present in the dietary protein consumed (Ambrose and Norr, 1993). However, the carbon measured in collagen can also be derived from dietary carbohydrates and fats (Jim et al., 2004; Richards, 2019). Bone collagen is constantly remodelled, but has a relatively slow turnover rate, and therefore provides insight into the average diet over a number of years prior to the death of an individual (Hedges et al., 2007).

Therefore to summarise, the isotopic values of human bone collagen can be used to trace dietary intake because the bone values reflect dietary isotopes values, which differ due to fractionation processes. Furthermore, because these isotopes are stable and do not decay over time, they reflect the values present at the time of formation.

4.6.1.2 Measurement

To quantify the stable isotope composition of bone collagen, the ratio of the heavier isotope to the lighter isotope (e.g., $^{13}C/^{12}C$) is measured in the sample material, and compared to the ratio in an international standard reference material (Richards, 2019). The difference between these ratios is the value of interest, and is expressed as a delta value (δ), with units of parts per thousand, or "*per mil*" (‰):

$$\delta = \frac{Rsample - Rstandard}{Rstandard}$$

When comparing the δ values of samples, higher values indicate relative enrichment in the heavier isotope, and vice versa.

4.6.1.3 Carbon isotopes

The carbon stable isotope composition of human bone collagen can be used to distinguish between the inclusion of plants with different photosynthetic pathways (C_3 or C_4 plants) at the base of the food web (Vogel and Van Der Merwe, 1977). Plants with a C_3 photosynthetic pathway constitute the majority of all terrestrial plants (80-90%), whereas C_4 plants are those adapted to tropical regions such as sorghum, millet, maize, and sugar cane (Hoefs, 2009:178). C_4 plants are more enriched in the heavier ^{13}C isotope compared to C_3 plants, owing to the manner in which they metabolise atmospheric carbon during photosynthesis. This difference is reflected in their respective $\delta^{13}C$ ranges: -9‰ to -14‰ for C_4 plants and -22‰ to -34‰ for C_3 plants (Deines, 1980; O'Leary, 1995). As there are no C_4 plants which are native to Britain, they are not expected to feature significantly in the dietary intake for the Thames individuals. Millet, a cereal, does appear in Britain from the Roman period onwards, though it is unlikely to have been a major dietary component (Müldner, 2013).

Various factors have an additional effect on the $\delta^{13}C$ value of C_3 plants. These include environmental variables, many of which are inter-related, including: atmospheric CO_2 levels, sunlight levels (e.g., the "canopy effect"), temperature, humidity, soil type, altitude, and water availability (Heaton, 1999). These environmental influences mean that $\delta^{13}C$ values for C_3 plants will vary across different temporal and spatial scales. Inter- and intra-species variations have also been noted for the $\delta^{13}C$ values of C_3 plants (Heaton, 1999). Furthermore, different parts of the same plant (e.g., leaves, seeds) may differ in their $\delta^{13}C$ values by 1-2‰. For the Thames Valley during the prehistoric period, Hamilton (2015:17) estimates that water availability and the amount of tree cover are likely to be the most important influences on plant $\delta^{13}C$ values, with differences of approximately a few per mil between plants from wet and well-drained habitats, or from open and shaded habitats.

Carbon stable isotopes may also be used to distinguish between diets based on marine or terrestrial resources (e.g., Schoeninger and DeNiro, 1984; Walker and Deniro, 1986). The main source of carbon for marine organisms is dissolved carbonate, which has a $\delta^{13}C$ value of 0‰, whereas atmospheric carbon, the main source for terrestrial organisms, has a $\delta^{13}C$ value of -7‰ (Katzenberg, 2008). Therefore, higher $\delta^{13}C$ values in areas with C_3 plant consumption could indicate consumption of marine resources. Petersone-Gordina et al., (2018:7) state that in general, a diet based entirely on marine resources will yield $\delta^{13}C$ values of around -12‰, while a C_3 diet with minimal or no marine input will result in $\delta^{13}C$ values around -21‰.

Freshwater ecosystems have many potential sources of carbon, and their $\delta^{13}C$ values are notoriously variable (Dufour et al., 1999; Richards, 2019). As such, they are generally not well-suited to the identification of freshwater resource consumption in the human diet.

Some further fractionation occurs as carbon passes up the food chain from plant to consumer bone collagen. Herbivore bone collagen is enriched in the heavier ^{13}C isotope compared to plant tissues, with $\delta^{13}C$ values which are approximately 5‰ higher (Ambrose and Norr, 1993). A further small increase in $\delta^{13}C$ values of 0-2‰ has been observed between herbivore collagen, and the collagen of the omnivores and carnivores which consume them (Schoeninger and DeNiro, 1984; Bocherens and Drucker, 2003; McCutchan et al., 2003; Richards, 2019).

4.6.1.4 Nitrogen isotopes

The stable nitrogen isotope composition of human bone collagen is widely used to identify the trophic position of humans in the local food web, e.g., whether they were primarily consuming plant or animal protein (meat/milk) (e.g., Lightfoot et al., 2009; Stevens et al., 2012). This is possible as there is an approximately 3-6‰ increase in $\delta^{15}N$ values at each successive trophic level in all food webs (e.g., from plant to herbivore, herbivore to carnivore) (Bocherens and Drucker, 2003; Hedges and Reynard, 2007; O'Connell et al., 2012). This trophic level enrichment also allows the consumption of aquatic (marine and freshwater) protein resources to be identified (Schoeninger and DeNiro, 1984). Food chains in aquatic ecosystems tend to be longer than terrestrial ones, and therefore humans with aquatic food intake will generally have higher $\delta^{15}N$ values than those consuming terrestrial resources (e.g., Walker and Deniro, 1986; Katzenberg and Weber, 1999).

To interpret their trophic position, human $\delta^{15}N$ values must be examined relative to those of a range of locally-available fauna. These fauna must be spatially and temporally contemporaneous with the humans in question, as various biological, environmental, and anthropogenic factors influence the isotopic composition of plants, and the animals which feed on them. For example, plant $\delta^{15}N$ values vary significantly depending on whether they are leguminous (utilising atmospheric nitrogen), or non-leguminous (utilising soil nitrogen) (Richards, 2019:135). As with carbon, the nitrogen isotope values of plants also differ on an intra- and inter-species level, and between different parts of the same plant (Bogaard et al., 2007). Environmental variables such as temperature, salinity, precipitation, and soil type, influence plant $\delta^{15}N$ values (Amundson et al., 2003; Szpak, 2014; Richards, 2019). Anthropogenic farming practices are also able to influence both plant and domestic fauna $\delta^{15}N$ values. For example, manuring can increase the $\delta^{15}N$ values of cereal crops (Bogaard et al., 2007), and controlling the access of domestic fauna to particular plant resources (e.g., foddering, salt marsh grazing) can affect the formation of their $\delta^{15}N$ values (Britton et al., 2008; Hedges et al., 2013).

As well as being influenced by dietary protein intake, it is important to note that human $\delta^{15}N$ values can also be affected by physiological processes operating within the body (Richards, 2019). Breastfeeding infants obtain their nitrogen from their mother's milk, and therefore occupy a higher trophic level and display correspondingly elevated $\delta^{15}N$ values (e.g., Schurr, 1998; Fuller et al., 2006).

Periods of nutritional stress or wasting have been demonstrated to elevate $\delta^{15}N$ values of body tissues, as nitrogen is metabolised within the body, instead of being obtained from dietary sources (Hobson et al., 1993). However, owing to its slow turnover rate, these processes are unlikely to be identified in bone collagen except in cases of prolonged and significant nutritional stress (Richards and Montgomery, 2012).

4.6.1.5 Sulphur isotopes

Compared to carbon and nitrogen, archaeological applications of sulphur stable isotope analysis are still at a relatively early stage, and are currently represented by only a moderate number of publications. Research has mainly been limited by the technical difficulties relating to the measurement of the $\delta^{34}S$ signature of bone collagen. However, recent methodological advances (e.g., Sayle et al., 2019) mean that the measurement of $\delta^{34}S$ values in bone collagen is becoming more routine. Various studies now attest to the potential for sulphur stable isotope data, particularly when combined with other isotope data, to yield more nuanced interpretations of diet and mobility among past human and animal populations (Richards et al., 2001; Privat et al., 2007; Nehlich et al., 2010, 2011, 2014; Linderholm and Kjellström, 2011; Jay et al., 2013; Sayle et al., 2013, 2016; Jay et al., 2019; Linderholm et al., 2014; Hamilton et al., 2019; Madgwick et al., 2019; Reade et al., 2020b,a; Walser et al., 2020).

Inorganic sulphur enters the food chain via plants at the base, which incorporate it into the biomolecular system. There is little fractionation in $\delta^{34}S$ values throughout the food chain, meaning that faunal values predominantly reflect environmental values (Nehlich, 2015).

The sulphur isotope values within a given food chain are highly environmentally-specific. Terrestrial plants obtain their sulphur largely from the soil (Richards et al., 2003:38). The main factor which influences the sulphur values of soil is the geology of the underlying bedrock; different types of rock can vary greatly in their $\delta^{34}S$ values, with the majority falling between -20‰ and +30‰ (Nehlich, 2015). Microbial processes in soils and atmospheric depositions (e.g., precipitation) can also influence the $\delta^{34}S$ values of plants across various scales (Richards et al., 2003).

The $\delta^{34}S$ values of marine ecosystems are remarkably constant, at around +20‰, due to the constant cycling of water through the oceans (Nehlich, 2015). A "sea-spray" effect is well-documented, whereby marine sulphur is transported inland via rain and aerosols, and can increase the $\delta^{34}S$ values of soils up to 30 km inland (Nehlich, 2015).

The $\delta^{34}S$ values of freshwater ecosystems demonstrate a high level of variability, and have been reported to range between -22‰ and +20‰ (Sayle et al., 2013). The sulphur isotope composition of freshwater environments mainly reflect the sulphur values of the surrounding geological formations, as mobile sulphur is leached into water sources, as well as the action of anaerobic bacteria residing within lakes and rivers (Peterson and Fry, 1987; Robinson and Bottrell, 1997; Nehlich, 2015).

This variability in the sulphur isotope signatures between different environments, both at a broad scale (i.e., between terrestrial, freshwater, marine ecosystems), and at more local spatial scales (e.g., between areas with different underlying bedrock geology) has allowed sulphur isotopes to be used as a tool for accessing both past diet and geographic mobility. It also means that, as with carbon and nitrogen isotopes, it is beneficial to sample a range of local fauna to establish the local ecosystem $\delta^{34}S$ baseline values when interpreting human values.

In terms of diet, in areas where there are clear distinctions between the $\delta^{34}S$ values of terrestrial, marine, or freshwater systems it is possible to infer the human consumption of foods from these systems (Richards et al., 2001). Sulphur isotopes have been particularly useful in the identification of freshwater resources in the diet (Privat et al., 2007; Hu et al., 2009; Nehlich et al., 2010, 2011), which is difficult on the basis of carbon and nitrogen isotopes alone. In terms of mobility, human and animal $\delta^{34}S$ values from a particular geographic area can be used to establish a "local" $\delta^{34}S$ signature (e.g., Hamilton et al., 2019; Madgwick et al., 2019).

4.6.2 Sample selection

Forty-two individuals curated at the Natural History Museum (40 from the River Thames assemblage and two from the Maynard Reservoir assemblage) were selected for inclusion in the stable isotope analysis. Selection was limited to remains which either already had an associated radiocarbon date, or were being included in the new programme of radiocarbon dating. An associated radiocarbon date was an

essential criterion for inclusion as without this temporal context, it would not be possible to interpret the isotope data. It was only possible to include remains curated at the Natural History Museum owing to the aforementioned sampling restrictions on human remains from the River Thames held at other institutions. Inclusion was limited to adolescent and adult individuals, owing to the effect of breastfeeding on the $\delta^{15}N$ values of infants (e.g., Fuller et al., 2006). Individuals with an age-at-death category of 0-11 years were excluded from analysis.

4.6.3 Faunal baseline data

As aforementioned, human stable isotope values must be examined alongside those of temporally and spatially contemporaneous fauna (termed faunal baseline data), as various local factors affect the isotopic values present at lower levels in the local food chain, which are then passed upwards. As there are no faunal remains which have reliable associations with the River Thames assemblage, faunal baseline data were instead generated from previously published isotopic data for Thames Valley sites.

Published carbon and nitrogen stable isotope data were gathered for fauna from sites in the Thames Valley, for all time periods relevant to this thesis (i.e., Neolithic to Post-Medieval, see Chapter 6). The geographic focus was limited where possible to sites in the Middle and Lower Thames Valley, as these areas are the most relevant to the recovery locations of the River Thames assemblage. However, if no data were available for a particular time period, the scope was extended to include the Upper Thames Valley. Carbon and nitrogen isotope data were collected for the three most commonly-encountered domestic terrestrial species across all time periods: cattle, ovicaprids, and pigs. The term “ovicaprids”, refers to the remains of both sheep and goats, and is often applied in archaeological studies as it is difficult to distinguish between these species osteologically (e.g., Privat et al., 2002; Bleasdale et al., 2019). In this study, the ovicaprids category includes both remains published as “ovicaprids” and “sheep”. It is expected that the majority of the ovicaprids will be the remains of sheep, as goat is generally rare in British archaeological assemblages (Hamilton, 2015:91). An overview of the faunal baseline $\delta^{13}C$ and $\delta^{15}N$ dataset is given in Table 4.7.

Site	Valley Section	Time Period	Species (*n*)			Reference
			Cattle	Ovicaprid	Pig	
Staines Road Farm	Middle	Neolithic	19	4	10	Hamilton 2015
Harlington	Middle	Neolithic	0	1	0	Hamilton 2015
		Bronze Age	9	2	3	
		Iron Age	2	0	0	
		Roman	7	11	2	
Heathrow Terminal 5	Middle	Bronze Age	9	13	0	Hamilton 2015
		Iron Age	11	4	1	
		Roman	6	4	0	
Eton College Rowing Course	Middle	Neolithic	5	1	3	Stevens et al., 2012
		Bronze Age	3	0	1	
		Iron Age	6	1	0	
		Roman	5	5	4	
Horton Kingsmeade	Middle	Neolithic	0	0	1	Hamilton 2015
		Bronze Age	0	1	0	
		Iron Age	2	4	0	
Runnymeade	Middle	Neolithic	28	15	20	Hamilton 2015
		Bronze Age	16	19	18	
Thorpe Lea Nurseries	Middle	Iron Age	14	14	11	Hamilton 2015
		Roman	28	33	9	
Wally Corner, Berinsfield	Upper	Medieval	4	2	1	Privat et al., 2002
Prescott Street, London	Lower	Post-Medieval	9	12	8	Bleasdale et al., 2019
Queen's Chapel, London	Lower	Post-Medieval	4	5	2	Bleasdale et al., 2019

Table 4.7: Sites included in the $\delta^{13}C$ and $\delta^{15}N$ faunal baseline dataset, shown alongside the number of each species present at each, broken down by time period.

4.6.4 Sample preparation

The sample preparation for the remains included in the isotopic analysis was conducted by the author, and is the same as that for the radiocarbon dating analysis (provided in Section 4.2.1.2).

4.6.5 Stable isotope measurement

The stable nitrogen ($\delta^{15}N$), carbon ($\delta^{13}C$), and sulphur ($\delta^{34}S$) isotopic compositions of the extracted bone collagen were determined at the Scottish Universities Environment Research Centre (SUERC), as described in Sayle et al., (2019). 20% of the samples were measured in duplicate and the measurement uncertainty was determined to be ±0.1‰ for $\delta^{13}C$ and $\delta^{15}N$, and ±0.3‰ for $\delta^{34}S$ on the basis of repeated measurements of an in-house collagen standard and the well characterised Elemental Microanalysis IRMS fish gelatin standard.

4.6.6 Statistical tests

Temporal trends in the different isotope values ($\delta^{13}C/\delta^{15}N/\delta^{34}S$) were statistically examined for the human data, and also within each of the faunal baseline species for carbon and nitrogen (i.e., cattle, ovicaprids, pigs). Statistical tests were selected according to the properties of the dataset in question (e.g., Roberts et al., 2018). If the data were normally distributed (examined using Shapiro-Wilks tests) then one-way ANOVA tests were performed to compare between mean time period values. If the data were normally distributed and of equal variance, one-way ANOVA tests with post-hoc Bonferroni correction were used. If the data were normally distributed but not of equal variance, Welch's ANOVA tests with post-hoc Games-Howell corrections were used. In two instances where the isotope data were not normally distributed for a species (cattle $\delta^{13}C$ and pig $\delta^{13}C$), a Kruskal-Wallis test with post-hoc Bonferroni correction was performed.

The correlation between the values of different isotope pairs was examined for the human data using Pearson's correlation tests. This test was selected as it is suitable for examining linear correlations between two normally-distributed continuous variables (normal distribution was confirmed for each isotope using Shapiro-Wilks tests).

All statistical tests were performed using SPSS version 27.0.

Chapter 5 Assemblage overview

The purpose of this chapter is to define the River Thames (Section 5.1) and Maynard Reservoir, Walthamstow (Section 5.2), human remains assemblages, and to provide an overview of their characteristics and context information. A chapter summary is given in Section 5.3.

5.1 The River Thames human remains assemblage

As aforementioned in Section 4.1.1.1 (assemblage selection), the River Thames human remains assemblage (also referred to as the “River Thames assemblage” and the “Thames assemblage”) is comprised of human remains recovered from the lower reaches of the River Thames. The full assemblage catalogue is presented in Table 4.1. The following sections describe the assemblage composition (5.1.1), spatial distribution (5.1.2), and recovery history and context (5.1.3).

5.1.1 Assemblage composition

A total of 237 human remains form the overall River Thames assemblage. The majority of these, 223 individuals, were accessed at first hand by the author and were osteologically recorded; these are termed the “osteological assemblage” throughout the text (see Section 4.1.1.1). The remaining 14 individuals could not be accessed at first hand and were not osteologically recorded (see Section 4.1.1.1); these are termed the “non-osteological assemblage” throughout the text. These individuals are still incorporated in aspects of the analyses (e.g., the demographic analysis), as described in the relevant sections of the preceding methods chapter (Chapter 4). Whether or not each individual was included in the osteological or non-osteological group is indicated in the assemblage catalogue in Table 4.1.

The vast majority of the individuals in the River Thames assemblage, 94.9% (225/237), are represented by single skeletal elements (see Figure 5.1). There are also two occurrences of articulated elements, and ten articulated skeletons (see Figure 5.1). Each occurrence is likely to represent a discrete individual, as the remains are subsequently shown to be well dispersed in time and geographic space (see Section 5.1.2 and Chapter 6). Even within discrete geographical locations (e.g., Mortlake), there is no compelling temporal overlap. Furthermore the majority of the isolated remains are represented by relatively complete cranial elements (see

Section 6.3.1.1), further reducing the likelihood of individuals being counted twice. However, as with any disarticulated assemblage, it is possible that 237 is a slight over-representation of the numbers of individuals present in the assemblage.

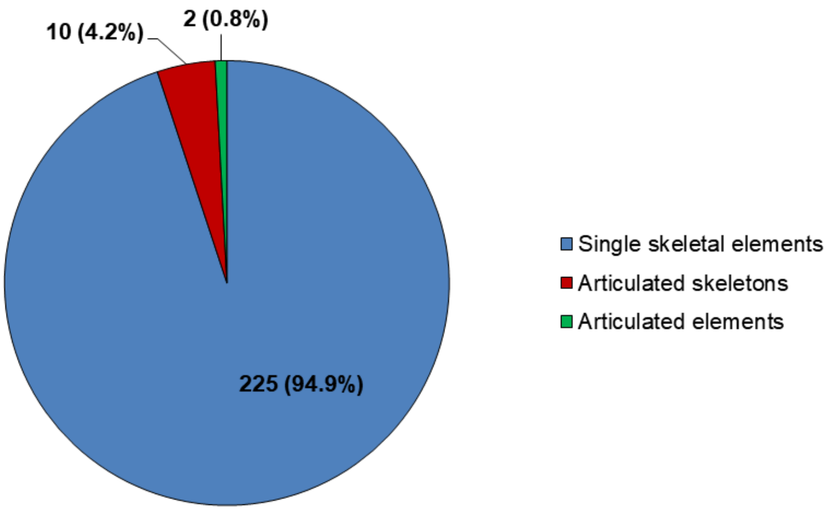

Figure 5.1: Pie chart presenting the element types which form the River Thames assemblage.

The majority of the single skeletal elements were recovered from the main river channel, 87.6% (197/225), and were dredged or probably dredged 84.9% (191/225), see Table 5.1. Unsurprisingly, none of the articulated skeletons (Table 5.2) or articulated elements were recovered through dredging, meaning that 80.6% (191/237) of the overall River Thames assemblage was recovered through historic dredging practices. A total of 21 individuals were recovered from the present Thames foreshore surface: 19 of these were single skeletal elements (Table 5.1), and two were articulated skeletons (Table 5.2). Both of the two articulated elements (not presented in a table owing to the small sample size) were recovered from associated deposits, one through construction work and one for which the recovery method is unclear.

Single skeletal elements							
Deposit		**Recovery method**					
Type	***n***	Dredged	P’dredged	F’ surface	Construction	Excavation	Unknown
Main channel	***197***	46	144	0	3	0	4
Present foreshore	***19***	0	0	19	0	0	0
Associated deposits	***9***	1	0	0	4	0	4
Former foreshore	***0***	0	0	0	0	0	0
Total n	***225***	***47***	***144***	***19***	***7***	***0***	***8***

Table 5.1: Recovery deposit and method distributions for single skeletal elements within the River Thames assemblage. “P’dredged”= Probably dredged, “F’surface”= Foreshore surface.

Articulated skeletons							
Deposit		**Recovery method**					
Type	***n***	Dredged	P'dredged	F'surface	Construction	Excavation	Unknown
Main channel	***0***	0	0	0	0	0	0
Present foreshore	***2***	0	0	2	0	0	0
Associated deposits	***4***	0	0	0	1	1	2
Former foreshore	***4***	0	0	0	0	4	0
Total n	***10***	***0***	***0***	***2***	***1***	***5***	***2***

Table 5.2: Recovery deposit and method distributions for articulated skeletons within the River Thames assemblage. “P’dredged”= Probably dredged, “F’surface”= Foreshore surface.

5.1.2 Spatial patterns

The overall spatial distribution of the River Thames individuals with associated geographic data is presented in Figure 5.2. Figure 5.3 and Figure 5.4 present “zoomed-in” views of the actual distribution of remains within each of the zones (see Section 4.1.1.2.4). Locations with more than one individual are shown as a single point, alongside the number of remains present. Locations are also colour-coded according to their specificity (see Section 4.1.1.2.4).

Of the overall River Thames assemblage, 31.2% (74/237) of individuals had no associated location information other than that they were recovered from the River Thames. A small number of these are known to have been dredged, and the rest were categorised as probably dredged.

The remaining two-thirds of the assemblage (163 individuals) had some level of associated spatial information, and these are represented by 71 discrete locations (shown in Figure 5.3 and Figure 5.4). The majority of these individuals, 74.2% (121/163) only had general location information e.g., “Mortlake”, “Hammersmith”, “Kew”. These are shown in red in Figure 5.3 and 5.4. As may be expected, these individuals were predominantly recovered by dredging, though not all. Twenty-nine individuals (17.8%; 29/163) had location information with approximate specificity (a potential find radius of ~200 m): e.g., SK 1511 found “opposite the Crabtree Inn at Putney”. These are shown in white in Figures 5.3 and 5.4. Only 14 individuals had exact location information, with associated geographic coordinates. Again, as may be expected, these were all recovered in recent years, either as foreshore surface finds, or during archaeological excavation or construction work. These are shown in green in Figures 5.3 and 5.4.

From Figure 5.2 it can be seen that the overall distribution of remains is fairly even along the course of the river, with 10-20 individuals in five of the eight zones. However, Mortlake to Hammersmith (zone C) is a dramatic anomaly, with 70 individuals.

This bias is due to the fact that 50 individuals were recovered from Mortlake (see box C in Figure 5.3 and Table 5.3), making it by far the largest single recovery location for Thames remains. All of the Mortlake individuals were recovered through

dredging or probable dredging, though at various times (see Section 5.1.3.1). All locations which have yielded more than two individuals are presented in Table 5.3.

Location	***n* of individuals**	**Recovery**
Mortlake	50	Dredged/probably dredged
Hammersmith	10	Dredged/probably dredged
Kew	9	8 dredged, 1 probably dredged
Putney Foreshore	9	Foreshore surface finds
Wandsworth	7	Dredged/probably dredged
Battersea	5	Probably dredged
Battersea Bridge	5	Probably dredged
Chelsea Foreshore	4	Foreshore surface finds
Chambers Wharf	3	Foreshore surface finds/archaeological excavation
Chiswick Reach	3	Dredged
Kew-Mortlake	3	Dredged
Northfleet	3	Dredged/unknown

Table 5.3: Locations from which more than two individuals in the Thames assemblage have been recovered.

5.1.2.1 Limiting factors to the interpretation of spatial patterns

There are several issues which need to be kept in mind in relation to the spatial patterning of the River Thames assemblage. The first is the lack of specificity in the geographical provenance information, which was highlighted in the preceding section. The large proportion of individuals with only general location information predominantly reflects the fact that the majority of the assemblage was recovered by historical dredging and antiquarian collecting activities. In their study of Bronze Age metalwork from the Middle and Upper Thames, Margaret Ehrenberg (1980:5) noted that “the dredger crews would note the provenance only in terms of the nearest town or bridge which might be two or three miles away; for example 'Thames at Taplow' may refer to anywhere within a reach three and a half miles long”.

Secondly, the apparent geographical distributions may reflect the intensity of certain activities in particular locations. In relation to the dredged remains, dredging activities are known to have been focused on particular stretches of the river (e.g., Ehrenberg, 1980:7; Schulting and Bradley, 2013:31). However, dredging records for the River Thames are largely lacking, which means it is not possible to meaningfully compare patterns of dredging intensity and location, with the recorded distribution of particular finds (Ehrenberg, 1980:5; Cotton, 1999:70). In relation to the human remains recovered from the present day foreshore, several factors are important to bear in mind. These include the fact that foreshore surveying and monitoring activities, such as those organised through the Thames Archaeological Survey (from 1996-1999) and then the Thames Discovery Programme (from 2008 onwards), focus on particular stretches of the foreshore (Cohen, 2017). Some Mudlarks are also known to preferentially search certain stretches of foreshore.

A third limitation affecting the spatial distribution patterns is the fact the antiquarian collectors focused their collecting efforts on specific stretches of the Thames (Ehrenberg, 1980:4). For example, Thomas Layton (1819-1911) had a collecting monopoly on Richmond and Wandsworth; Hume (1956:23) describes how “he was known to every Tom, Dick and Harry who had the slightest connection with that stretch of the Thames, and as soon as a relic was found the cry would go up, “Take it to Mr Layton””. The geographical distribution of the human remains may to some extent reflect such preferences.

A final limitation relating to the geographical distribution of remains is the fact that during Thames construction projects, vast quantities of material from the river bed were removed and deposited elsewhere along the river (Cotton, 1999:65). For example, Lawrence (1929:72) described how material dredged in the construction of the new London Bridge (1824-1831) was redeposited in various locations, including at Hammersmith and Wandsworth. Cotton (1996:93) reported how the downstream end of Battersea Reach had received vast quantities of material which had been dredged and excavated from various locations further downstream including Woolwich, the London Docks, and the Royal Exchange since at least the 1820s. Any archaeological objects within these gravels, such as human remains, would have also been relocated, and some evidence can be found of this for artefacts recovered from the present day foreshore (Cotton and Wood, 1996:29).

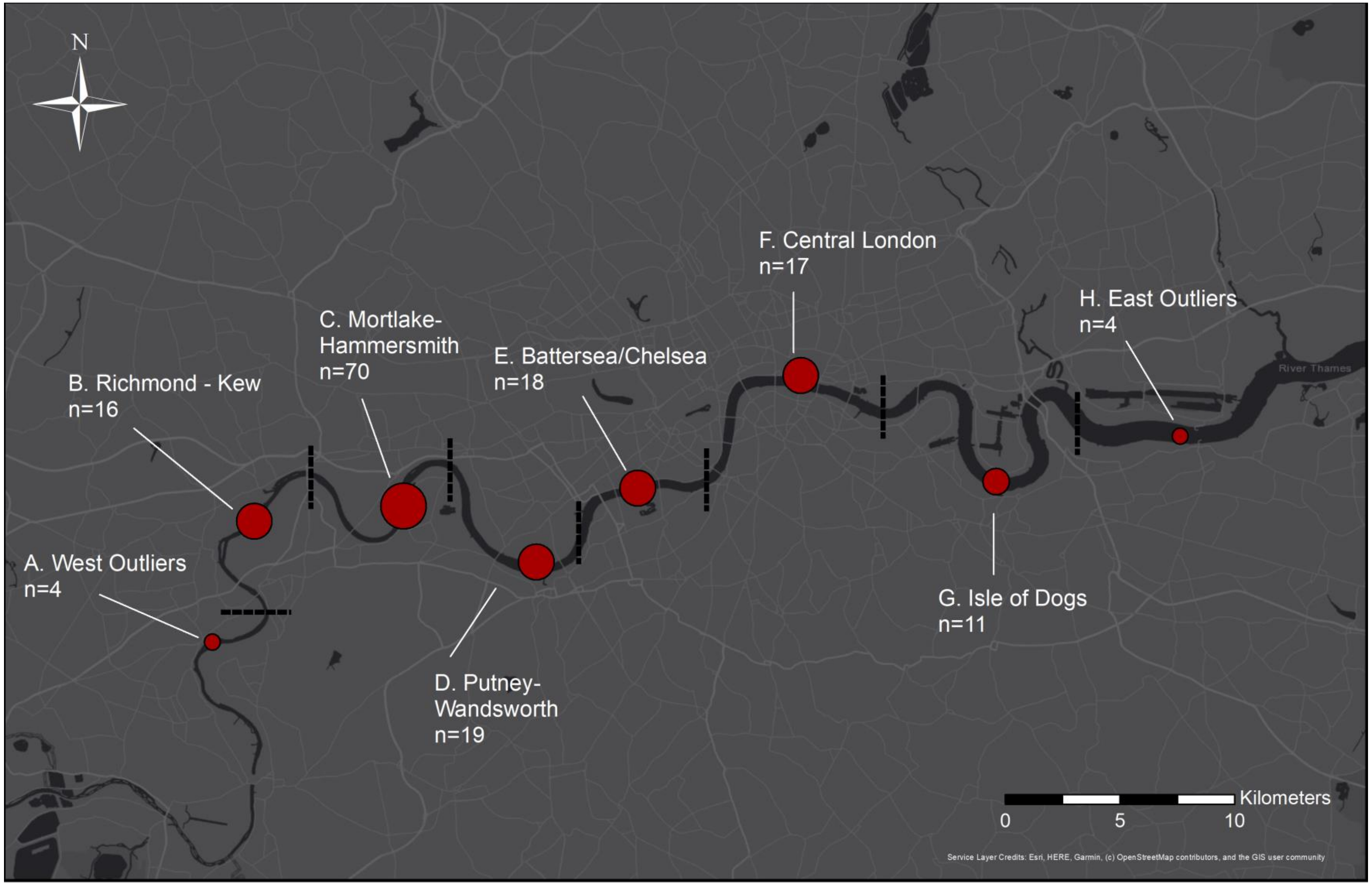

Figure 5.2: Map showing the spatial distribution of human remains within the River Thames assemblage, according to river zone. The marker sizes are proportionate to the number of remains from the zone in question. See Section 4.1.1.2.4 for information on the zones.

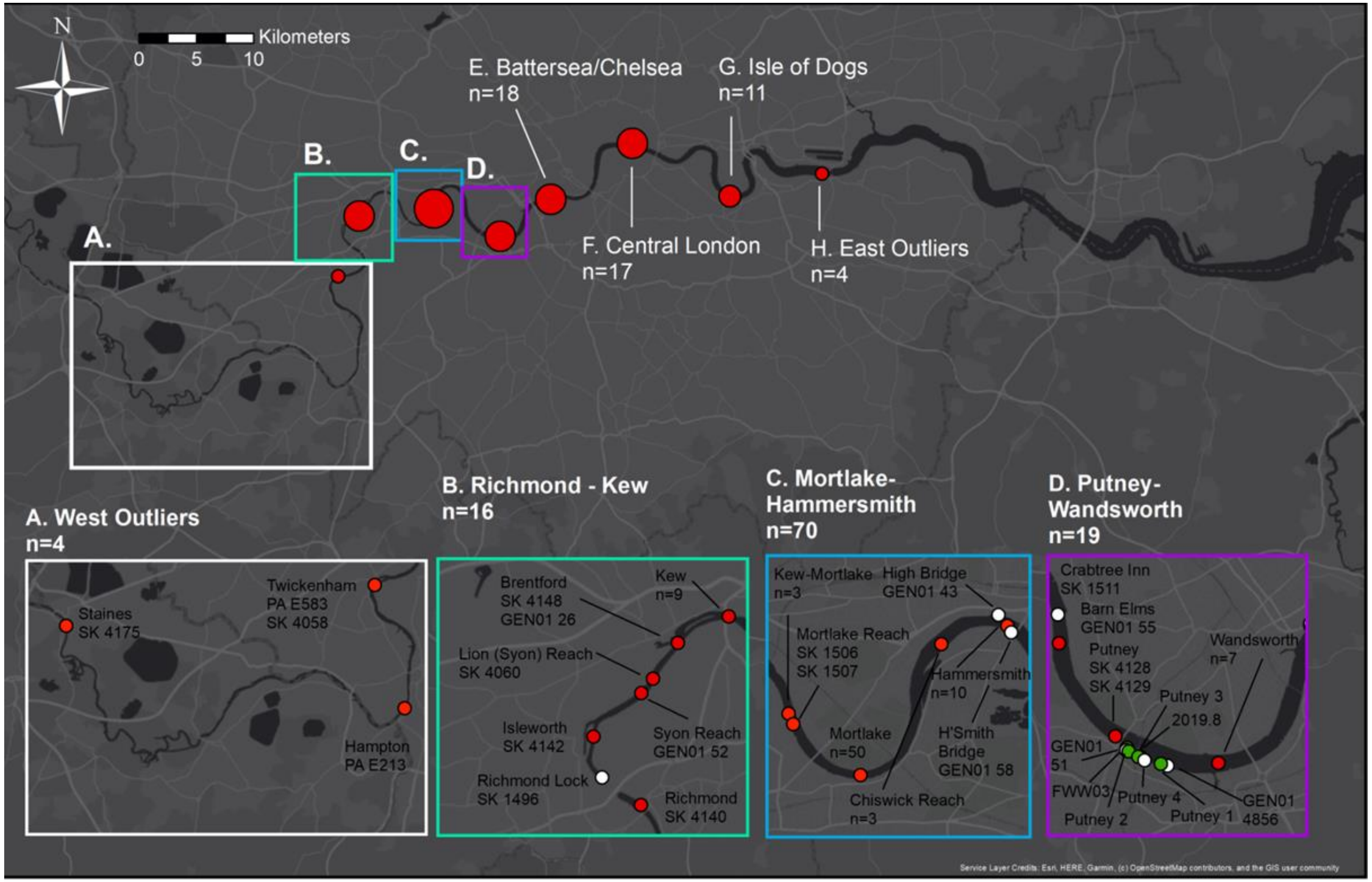

Figure 5.3: Map showing the spatial distribution of human remains within the River Thames assemblage, zones A-D. The inset maps illustrate the individual find spots. Find spots are colour-coded according to the specificity of their spatial information: general locations are coloured in red, approximate locations in white, and exact locations in green.

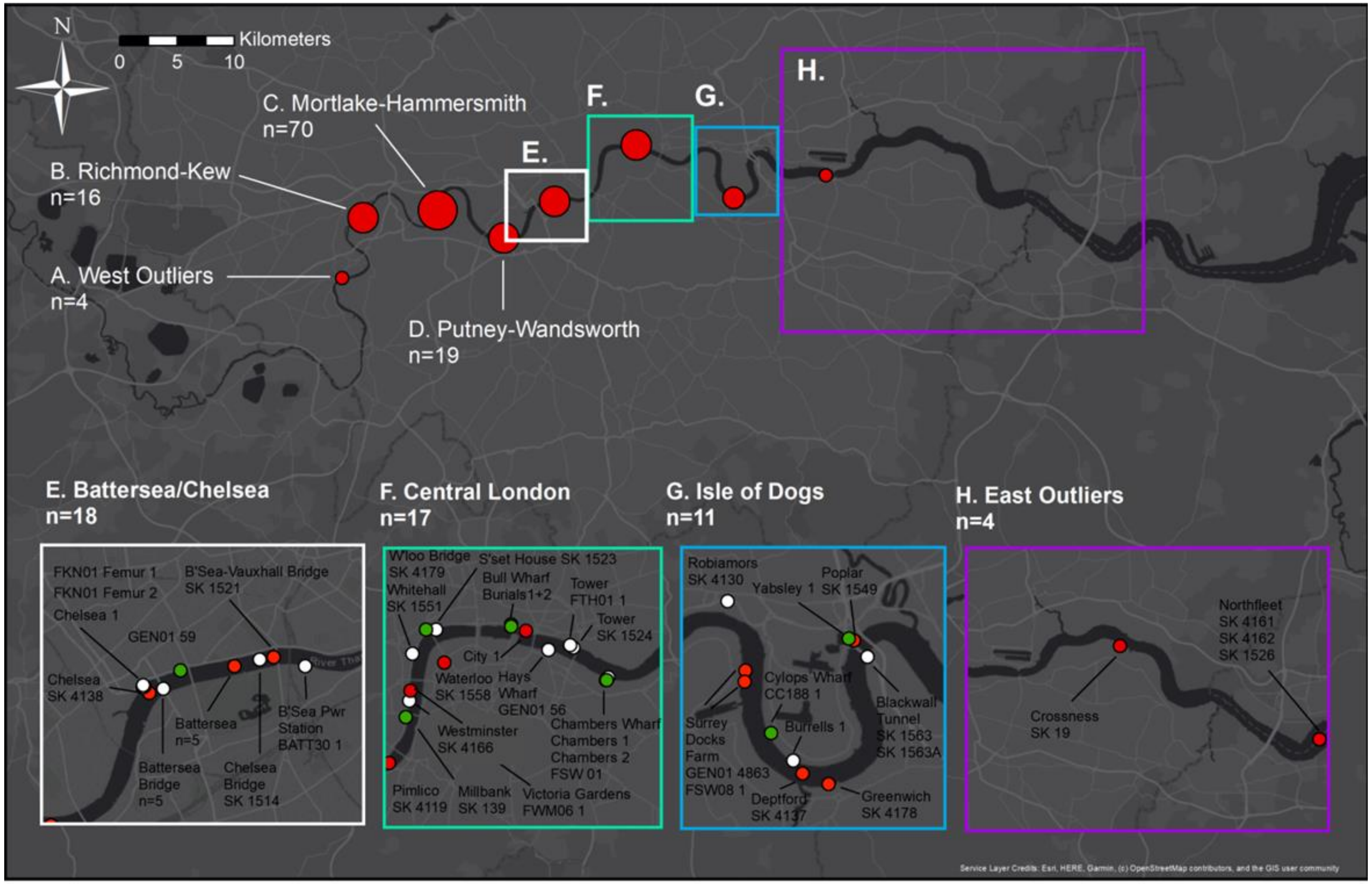

Figure 5.4: Map showing the spatial distribution of human remains within the River Thames assemblage, zones E-H. The inset maps illustrate the individual find spots. Find spots are colour-coded according to the specificity of their spatial information: general locations are coloured in red, approximate locations in white, and exact locations in green.

5.1.3 Assemblage history and context

5.1.3.1 Dredged remains

Limited contextual information is available for the dredged/probably dredged portion of the River Thames assemblage (191 individuals), which are all curated at the Natural History Museum and the Museum of London. The majority have associated general spatial information, though 73 (38.2%, 73/191) are recorded only as being from the River Thames. A small number of individuals, though not enough for a meaningful presentation of data, have additional information such as: the date or depth of dredging, and the stratum from which they were thought to have originated (e.g., "deep ballast", or "alluvium"). The earliest secure date for dredging is 1863 (SK 1521, dredged between Battersea and Vauxhall Bridge), and the latest is 1924 (SKs 4107 and 4108 from Mortlake). A very small number of dredged remains are reported to have been directly associated with artefacts. SK 4175, a calotte dredged at Staines is recorded as having been found with Bronze Age objects. Six individuals from Mortlake (SK 4101-6) are recorded as having been found with "flint celts"; one of these (SK 4105) was included in the new programme of radiocarbon dating and returned a Late Bronze Age date (see Chapter 6). Figure 5.5 shows the label associated with one of these Mortlake "flint celt" individuals, and is an example of excellent associated context information for dredged remains.

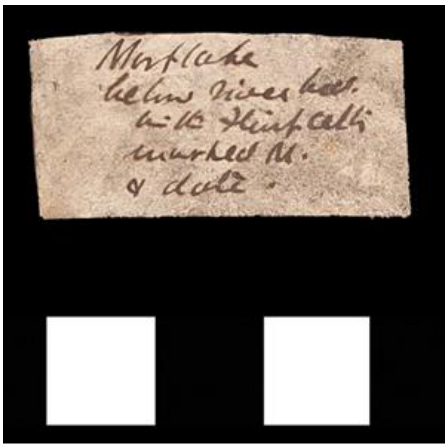

Figure 5.5: Label associated with SK 4102 from Mortlake. Label reads "Mortlake below river bed with flint celts marked M. & date". Scale is 1 cm. © The Trustees of the Natural History Museum, London.

Some of the dredged/probably dredged remains can be directly associated with antiquarian collectors. The most prolific collector appears to have been Frank

Corner (1897-1934), a surgeon from Poplar, whose name is associated with 76 of the Thames remains. Other notable collectors include: Augustus Wollaston Franks (1826-1897), a former curator at the British Museum, who is associated with six crania; and Joseph Barnard Davis (1801-1881) who is associated with five crania recovered from the area around Battersea Bridge, which are briefly described within his 1867 work *Thesaurus Craniorum*.

A group of fifteen dredged crania were collected by G.F. Lawrence, Inspector of Excavations for the London Museum, before he gave them to the Natural History Museum, "where they will be preserved for future reference and study" (Garson, 1891:25). It has been noted that G.F. Lawrence endeavoured to provide detailed records for River Thames finds, contra to other the antiquarian collectors (e.g., Hume, 1956:25), and this holds true for the human remains. Two publications were produced relating to the crania in 1891: one by Lawrence himself, detailing their find locations and geological positions (Lawrence, 1891), and one by Dr J.G. Garson, an anthropologist, providing anatomical descriptions (Garson, 1891).

Lawrence (1891) notes that the remains were dredged "at various times" from Kew (n=8), between Kew and Mortlake (n=3), Hammersmith (n=2), Lion Reach (n=1), and Twickenham (n=1). These Kew individuals account for all but one of the total remains recovered from Kew (see Table 5.3). Several generalised remarks are made about all of the crania, excluding the Lion Reach and Twickenham individuals for which Lawrence (1891) states he was unable to find information. They are reported to be from the lowest layer of the river bed, in the stratum directly above "the London clay", and immediately below layers of hard concretionary crust (Lawrence, 1891). No artefacts were reported to have been found with the crania, but Lawrence notes that "implements of stone, bone, and bronze have been found in this stratum, years ago, while antiquities of iron only seem to occur in the higher strata" (1891:27). The nine Kew crania are all reported to be from a stratum between approx. 2 ½-8 ft deep of "coarse black gravel, encrusted with carbonate of lime" and to have been "intensely black" with a quantity of the calcareous concretion on them when found (Lawrence, 1891:26-27). The three crania from between Mortlake and Kew were recovered from a stratum between approx. 2ft-10 ft deep of "sand passing into gravel, getting coarser towards the bottom, and covered with calcareous concretions" (Lawrence, 1891:26). The two crania from Hammersmith were reported to be from a stratum of "sandy gravel with occasional pieces of decayed wood and numbers of large mussel shells" at a depth of approximately 9 ft (Lawrence,

1891:26). Radiocarbon dates were produced for three of these remains from Kew as part of the new programme of radiocarbon dating implemented for this thesis: two were Late Bronze Age in date (SK 4062, SK 4067), and one Late Iron Age (SK 4055) (see Chapter 6).

An interesting story relating to G.F. Lawrence emerged during the course of research for this thesis, and may account for the origins of some of the Thames assemblage. Writing about a trepanned calvarium dredged near Hammersmith Bridge, Parry (1921:29) described how it was formerly part of Thomas Layton's (1819-1911) collection, along with a number of other skulls from the river. In 1914, after Layton's death, the skulls were auctioned off: a commonly accepted practice at the time, particularly for museums or collectors to acquire British archaeological artefacts. Parry (1921:29) reports that G.F. Lawrence attended the auction, though was late to arrive, and found that "a hamper of skulls had been put aside, unsold, for the purpose of being crushed up to make mortar". Lawrence purchased the skulls for "a few shillings", the trepanned calvarium was transferred to the London Museum (which later became the Museum of London, and is where this calvarium still resides: GEN01 58, see Section 7.7.2.3), and the rest were transferred to the Royal College of Surgeons (Parry 1921:29). The sales catalogues for these 1914 auctions, made available through the Layton Trust, make several mentions of lots containing bones and skulls, including one of "twenty-nine human skulls", but provide no illuminating details.

It is likely that individuals from this "hamper of skulls" are present within the River Thames assemblage curated at the Natural History Museum. Here there are 63 individuals with no associated information other than that they were recovered from the River Thames, and were formerly in the collections of the Royal College of Surgeons, which is the institution to which the majority of the "hamper of skulls" had been given. Once cast aside for making mortar the remains are unlikely to have been associated with any specific context information other than that they were recovered from the Thames. Furthermore, Thomas Layton was notorious for keeping poor records of his finds (Hume, 1956:25), so it is also possible that they never had more detailed information associated with them. Additionally, six of these crania have "11/9/17, River Bed, Lawrence" inked on them, providing evidence of association with G.F. Lawrence shortly after the sale in 1914; perhaps these labels were added on their subsequent accession to the Royal College of Surgeons.

It is possible to speculate that some of these Thames/RCS remains could be a portion of the hundreds of skulls recovered from the river at Strand-on-the-Green near Kew, which are reported in historic publications (e.g., Lawrence, 1929), but the physical remains of which are missing, not being present within either the Natural History Museum or Museum of London collections. Thomas Layton lived nearby at Kew Bridge Road, and his main collecting territory was from Richmond to Wandsworth (Hume, 1956:23). He was also among the most prolific of all collectors of Thames finds (Hume, 1956:22-23) and, as aforementioned, was notoriously bad at documenting his collection even by antiquarian standards (Hume, 1956:25).

5.1.3.2 Remains recovered from the present day foreshore

Twenty-one human remains have been recovered in recent decades from the present day Thames foreshore: 19 of these are single skeletal elements (Table 5.1) and two are articulated skeletons (Table 5.2). These were all recovered as chance surface finds between the 1990s and 2019, mostly by individuals who regularly walk certain sections of foreshore looking for archaeological objects (e.g., mudlarks, under licence from the Port of London Authority), and some during archaeological monitoring surveys of the foreshore by Thames Archaeological Survey/Thames Discovery Programme. Correspondingly, some of the remains have comparatively good associated contextual information, such as coordinates of their exact place of recovery.

Spatially these remains are distributed from Putney in the west, to Surrey Docks Farm on the Rotherhithe peninsula (see box G in Figure 5.4). The Putney foreshore on the south bank of the Thames is a particularly prolific location: nine single skeletal elements have been recovered from here on separate occasions, across an approximately 1 km stretch of foreshore (see Figure 5.6). Four of these have exact location information (shown in green in Figure 5.6), and it is apparent that these were recovered some distances apart, with the exception of GEN01 51 and Putney 2. Interestingly, five of these elements have been radiocarbon dated externally to the current project, and range in date from the Neolithic to Iron Ages (as discussed in detail in Chapter 6).

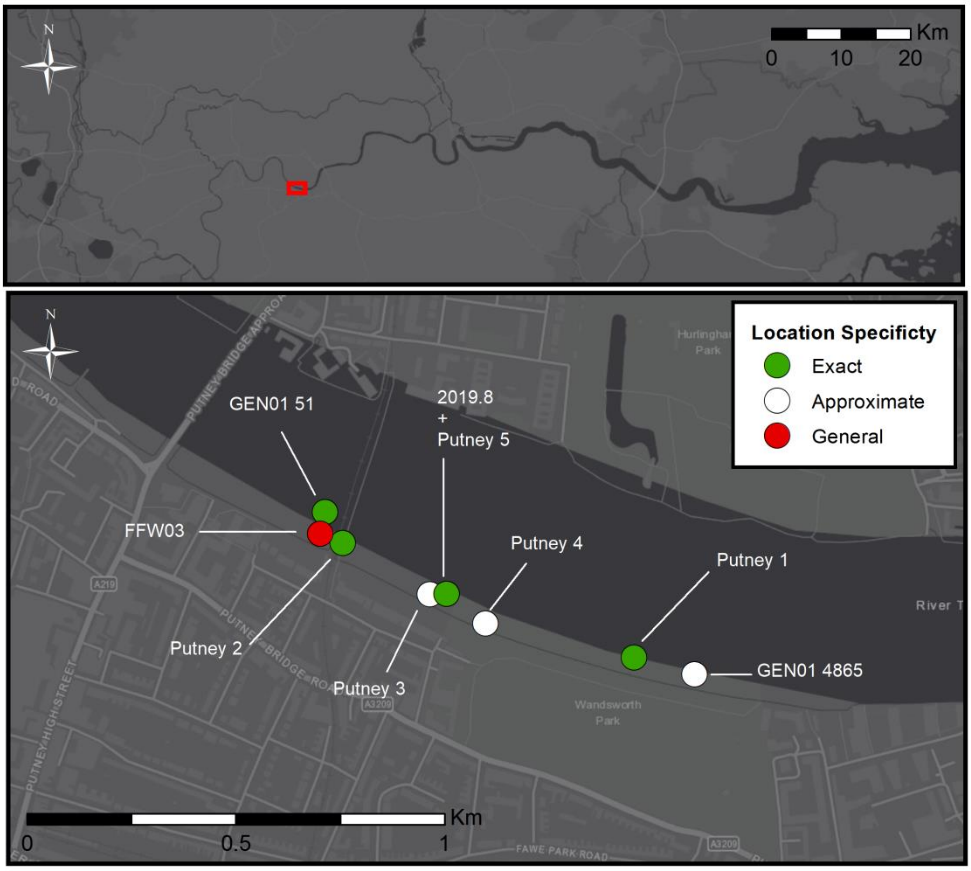

Figure 5.6: Map of the Putney foreshore indicating the recovery locations and specificity of the human remains.

Four skeletal elements have also been recovered from the foreshore surface at Chelsea in recent years, on separate occasions, in the area of Cheyne Walk Moorings (Thames Discovery Programme site code FKN01), see box E in Figure 5.4. All were recovered by individuals with an archaeological background during foreshore surveys: one in the 1990s, one in 2001, and one in 2006. Interestingly, these remains comprise three femora, and a trepanned cranial fragment. Three of the four remains have been radiocarbon dated externally to this thesis, and date to the Neolithic and Middle Bronze Age (see Chapter 6). The trepanned cranium, dated to the Middle Bronze Age, is reported to have been partly embedded in a submerged Neolithic forest peat bed, in which the remains of oak leaves, acorns, and animal bones could be seen (Edwards et al., 2009).

The two articulated foreshore skeletons were recovered further to the east, from the foreshore at Chambers Wharf (see box F, Figure 5.4) and Burrells Wharf (see box G, Figure 5.4). Both have been dated to the Post-Medieval period (see Chapter 6).

The remains recovered from the present day foreshore surface present an important, yet previously overlooked, comparison sample for interpretations drawn from the dredged remains: which are more numerous but with, as has been demonstrated, less secure recovery history and context.

5.2 The Maynard Reservoir human remains assemblage

5.2.1 Overview

As introduced in Section 4.1.2, the Maynard Reservoir assemblage is a small group of human skeletal remains which were recovered along the course of the River Lea at Walthamstow in the late 1860s, during a period of reservoir construction. Late Bronze Age radiocarbon dates for two individuals who presented perimortem injuries were obtained previously by Schulting and Bradley (2013), see Chapter 6. The assemblage catalogue is presented in Table 4.2. The following sections describe the relevant archaeological context and collection history: firstly at a broad level (Section 5.2.2), and then more specifically to the human remains assemblage (Section 5.2.3).

5.2.2 The Walthamstow Reservoirs: excavations and archaeology

The East London Water Company constructed a series of reservoirs along the course of the lower River Lea, about 20 km north of the River Thames, in the late 19th and early 20th centuries. The reservoirs and their approximate construction dates are outlined in Table 5.4 below, and their locations in Figure 5.7.

Reservoir	Date of construction	Source
Reservoirs 1-3	Completed 1863	Walthamstow Wetlands
Reservoirs 4-5	Completed 1866	Walthamstow Wetlands
Maynard Reservoirs (High & Low)	1868-1869	Hatley (1933)
Warwick Reservoirs (East and West)	Completed 1895	Walthamstow Wetlands
Lockwood Reservoir	1900-1901	Hatley (1933)
Banbury Reservoir	1900-1901	Hatley (1933)

Table 5.4: The Walthamstow Reservoirs, shown alongside their approximate date of construction.

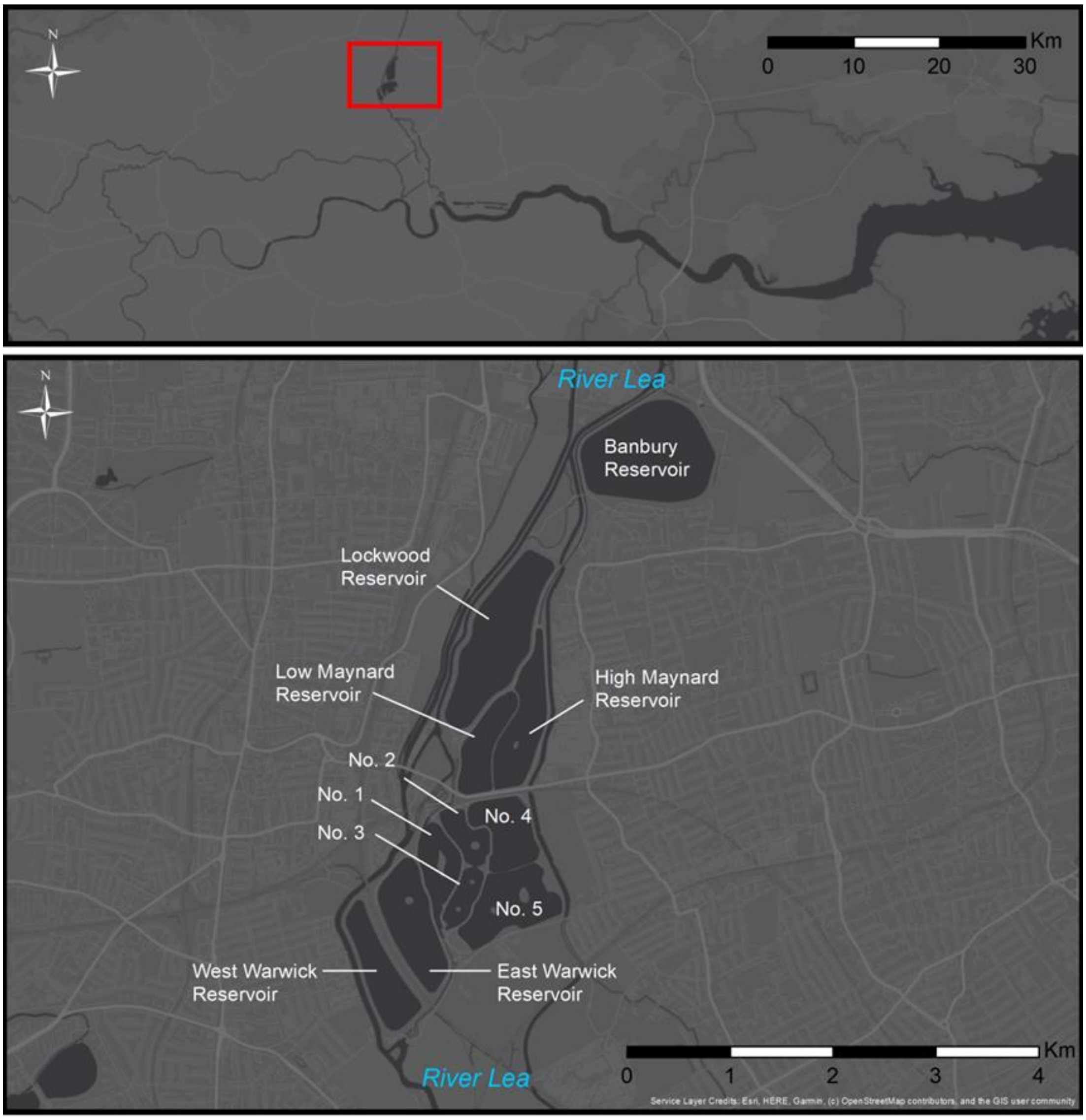

Figure 5.7: Map showing the locations of the Walthamstow Reservoirs, and their positions relative to the River Lea.

The excavations yielded numerous archaeological finds, which are best known from the Maynard, Lockwood, and Banbury Reservoirs, possibly owing to the fact that contemporary accounts of these excavations were produced (see Woodward 1869 for the Maynard Reservoir; and Holmes 1901 for the Banbury and Lockwood Reservoirs). An informative account of the excavations was also created some years later by Ruth Hatley (1933).

The excavations for the Maynard Reservoir generally reached depths of no more than 10 ft (Woodward, 1869) and 9-11 ft for the Lockwood and Banbury Reservoirs (Holmes, 1901). In all of the aforementioned reservoirs, irregular layers of peat and shell marl were reported between the surface loam/clay and basal gravels of many

sections (Woodward, 1869; Holmes, 1901). Woodward comments that the shell marl layers consisted of a “vast accumulation of land and freshwater shells” (1869:385), and that within the peat “abundant remains of forest vegetation” could be seen, including the remains of oak, hazel, and alder (1869:386).

The archaeological finds were numerous, varied, and spanned a broad time range: most notably covering the Bronze Age to the Early Medieval periods. Numerous pieces of Late Bronze and Iron Age metalwork were recorded, including spearheads, axes, and swords (Hatley, 1933). Two wooden boats were uncovered at the Lockwood Reservoir, causing great excitement at the time owing to their supposed antiquity (Hatley, 1933), but which were later radiocarbon dated to the Early Medieval and Post-Medieval periods (Fenwick, 1978; Switsur, 1989). Two wooden “pile-dwelling” structures were also reported: one at the Maynard Reservoir, of which a scale drawing was made at the time of the excavations by Frank Corner (Hatley, 1933; see Section 5.2.3.1 below); the other at the Banbury Reservoir, the only reference for which exists in the first-hand account reported by Hatley (1933:16): “In 1900 I saw the remains of a crannog in the Banbury Reservoir. I saw only the bottoms of the piles all in situ and arranged in rows”.

Human and animal bones were reported to have been found in the peat and shell marl at the Maynard Reservoirs (Woodward, 1869).

Many of the finds from the Maynard Reservoir excavations were purchased from the workmen by Joseph Wood, a collector of fossils (Woodward, 1869). The animal remains were subsequently purchased from him by the Natural History Museum (Hatley, 1933), where they still reside today. It is also apparent that the human remains followed the same route (see Section 5.2.3 below). Many of the artefacts were purchased by A.W. Franks of the British Museum (Woodward, 1869), where they also still reside.

5.2.3 The human remains assemblage

Little information about the human remains exists within the associated museum documentation (e.g., associated labelling/index cards). They are noted to have been found during excavations for a reservoir at Walthamstow, and to have been purchased by the museum from Joseph Wood in August 1869. Six of the associated index cards/labels also note that the remains were found in deposits of shell marl

with the remains of wolf and beaver, and in one case with wolf, beaver, red deer, and goat.

From this information it is possible to confidently link the human remains to those reported from the Maynard Reservoirs by Woodward (1869), mentioned above. Their description and circumstances of their purchase are all highly concordant: i.e., found in the shell marl, and purchased from Joseph Wood in 1869.

5.2.3.1 Frank Corner and the Maynard Reservoir "cranoge"

Furthermore, it is possible to associate the human remains assemblage with the pile-dwelling structure encountered in the Maynard Reservoir excavations. As part of collection provenance research, we sought access to the scale drawing of the Maynard Reservoir "cranoge" produced by Frank Corner at the time of the excavations in 1868-9. No copy of the drawing has been published previously, but Hatley (1933) stated it was held in the Museum of London collections, and fortunately this is where it is still curated today and can be viewed.

It can be seen from the drawing (Figure 5.8) that two groups of human remains were found in close association with the wooden structure (numbers 19 and 22, labelled in red). These appear from the scale to have been separated from each other by approximately 35 metres. The human bones found at number 19, in the middle of the structure, are reported to have been found with the bones of "rhinoceros, ox, horse, pig, and red deer horn" (see Figure 5.8). The remains at number 22 are described thus: "bones found here, including human bones" (Figure 5.8), implying that non-human bones were also recovered in the same place. These may be the animal remains described in the labelling associated with some of the human remains (i.e., wolf, beaver, red deer, and goat). The number 22 bones were found in-between deposits of shell marl (numbers 13 and 17), which further matches with the human remains labelling (see Section 5.2.3). They were also in close proximity to deposits of peaty and sandy material (numbers 14, 15, 16). It is possible that the human remains comprising the NHM Walthamstow assemblage may have been recovered from elsewhere within the Maynard Reservoir, but the evidence strongly suggests that they are those associated with the wooden structure.

It is not clear what this wooden structure represents: some form of crannog or pile-dwelling as hypothesised at the time of discovery, or something else entirely. "Lake

dwelling fever” was sweeping across Europe at the time, owing to discoveries at La Téne in Switzerland the 1850s, and lake dwellings were being identified in multiple countries (Fitzpatrick, 2018:45). The excavations were still underway at the time of the drawing, and the full extent and shape of the structure are unclear. However it appears to have been large: the drawn section is about 60 metres long and 25 metres wide. The wooden piles are described as being pencil-shaped, about 4 ft 6 inches high, and spaced about 7-9 inches apart (number 18, Figure 5.8). Therefore, the piles were quite densely packed together, but they do not appear from the drawing to have had a particularly organised internal structure. Interestingly, a series of Bronze Age timber revetments have recently been found lining palaeochannels of the River Lea about 10 km further up the Lea Valley at Innova Park (Ritchie et al., 2008). Late Bronze Age midden-like deposits are also reported from the base of one of these revetments.

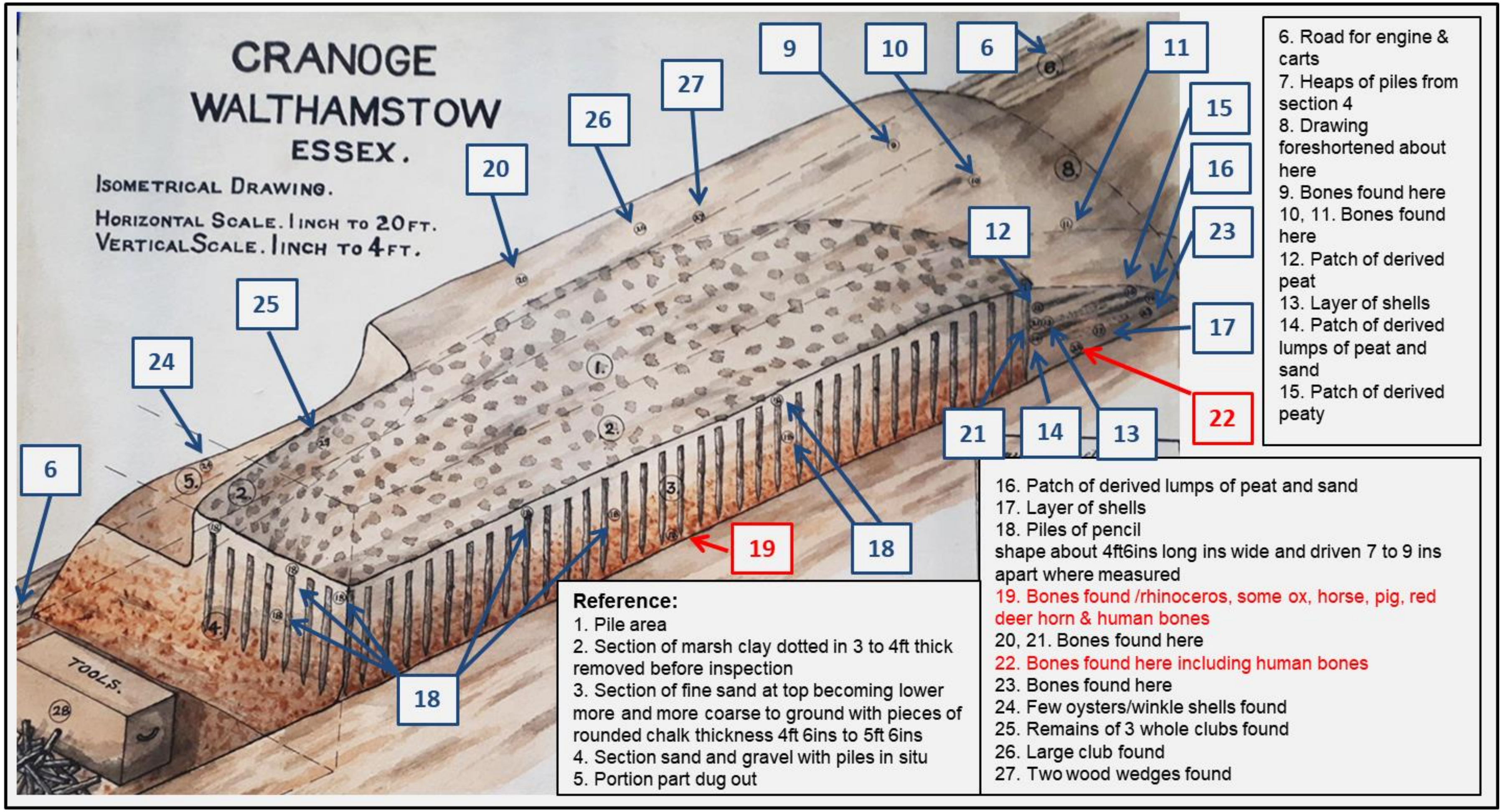

Figure 5.8: Re-annotated version of the scale drawing of the "cranoge" uncovered at the Maynard Reservoir, created by Dr Frank Corner at the time of excavation in 1868-1869. The two locations where human remains were found are indicated in red. Reproduced with permission of Museum of London.

5.2.3.2 Environmental context

Deposits of sand, peat, and shell marl were all recorded in close proximity to the human remains (Figure 5.8), and the labels associated with the eight of the elements directly specify that they were found in the shell marl. Specific stratigraphic information is not provided for the other elements, so it is not clear whether they were also recovered from the shell marl, or from other deposits.

Recent excavations around 8 to 10 km further upstream along the course of the River Lea at Innova Park (Ritchie et al., 2008) and Enfield Lock (Chambers et al., 1996) have revealed stratigraphic similarities with the Maynard Reservoir crannog site. At Enfield Lock, a shell marl layer was identified below overlying clay layers and above organic muds and gravels. This was rich in aquatic molluscs, and also included a smaller number of "swampy" and land species. The shell marl was considered to have likely been formed by rising water levels, and to indicate the presence of a slow-flowing river, surrounded by fen and marsh (Chambers et al., 1996:9). The marl deposits were not directly dated, but were estimated to have begun to form during the Late Neolithic. It is likely, though not possible to confirm, that the presence of shell marl at the Maynard Reservoir site is related to similar environmental conditions.

At Innova Park, no deposits of shell marl were identified, but periods of overbank flooding were identified in Late Bronze Age contexts (Ritchie et al., 2008).

5.2.3.3 Associated artefactual assemblage

In addition to the human remains, numerous artefacts were associated with the wooden structure, a small number of which were recorded in the drawing (Figure 5.8), and others of which were reported in published literature (e.g., Hatley, 1933). The objects reported to have been associated with the structure are listed in Table 5.5. This is obviously likely to be a biased subsample of the actual buried assemblage, owing to the various issues surrounding antiquarian collecting activities (e.g., focusing collecting efforts on the most distinctive artefacts (Fitzpatrick, 1984)).

However, a range of artefact types were recovered, from weapons to domestic items (Table 5.5). Chronologically these span the Middle Bronze Age to Romano-British

periods, but there is a notable concentration of Iron Age artefacts. Of particular note are two Iron Age cauldron bases, both of which are curated at the British Museum (OA.10953-4; see Figure 5.9). Both cauldrons were included in a study by Joy (2014), who gives an approximate date range of the 4^{th}-1^{st} centuries BC for these cauldron types.

To summarise, the assemblage of human remains from the Walthamstow Reservoir, curated at the Natural History Museum, have been demonstrated to have been recovered from the Maynard Reservoir, and highly likely to be those which were found in association with the wooden structure shown in Figure 5.8. The exact nature of this structure remains unclear, though numerous artefacts, many of which are Iron Age in date, were reported to have been found in close proximity.

Object Type	**Probable period**	**Museum ID**	**Association with structure**	**Reference/Source**
Iron-socketed axe	Early Iron Age	1882,0424.6	Definite	Hatley 1933:16
Iron spearheads	Iron Age	NA	Definite	Hatley 1933:16
Eight well-preserved pottery vessels	Early Iron Age	Includes 1869,0726.7, shown in Fig 13 of Hatley 1933	Definite	Hatley 1933:16 / Drury, 1980:53
Bone knives	Unknown	NA	Definite	Hatley 1933:16
Wooden pegs	Unknown	NA	Definite	Hatley 1933:16
Wooden mallets	Unknown	NA	Definite	Hatley 1933:16
Clay spindle whorl	Unknown	1903,0214.20	Definite	Hatley 1933:16
Shale armlet	Iron Age/ Romano-British	1903,0214.19	Definite	Hatley 1933:16
Two copper-alloy cauldrons	Middle Iron Age, 4^{th}-1^{st} century BC (see Joy 2014)	OA.10953-4	Probable	Hatley 1933:17
Bronze basal-looped spear head	Middle Bronze Age	1873,0210.9	Probable	Rowlands, 1976:1541
Four wooden “clubs”	Unknown	NA	Definite	F. Corner drawing (Fig. 5.4) numbers 25 and 26
Two wooden wedges	Unknown	NA	Definite	F. Corner drawing (Fig. 5.4) number 27

Table 5.5: Archaeological artefacts with a reported association with Maynard Reservoir wooden structure. The museum IDs given are British Museum object registration numbers.

Figure 5.9: Middle Iron Age cauldron base probably found in association with the Maynard Reservoir wooden structure. British Museum registration number OA.10954. © The Trustees of the British Museum

5.3 Chapter summary

This chapter has provided an overview of various features of the River Thames assemblage, including the assemblage composition, spatial patterning, and its recovery history and context. The majority of the River Thames assemblage was found to be comprised of single skeletal elements, the majority of which were recovered through historical dredging activities and thus only have fairly limited contextual information (e.g., recovery location). However, there is also a moderate subsample of human remains which have been recovered from the present day foreshore in recent decades (21 individuals), which will be used where possible to provide a comparative sample for interpreting the patterns observed in the larger, but more poorly contextualised, subsample of dredged remains.

The “Walthamstow” assemblage of human remains curated at the Natural History Museum have been demonstrated to have been recovered from the Maynard Reservoir, and to have very likely been associated with a substantial wooden structure, and potentially a wider artefactual assemblage.

Chapter 6 Chronology and the taphonomic histories of the assemblages

This first part of this chapter addresses Aim A: to further understanding of the temporal patterning within the assemblages. The results of the new programme of radiocarbon dating are presented in Section 6.1.1, and these are combined with radiocarbon dates generated externally to this thesis to present the overall temporal dataset in Section 6.1.2. Spatial patterning in the temporal dataset is examined in Section 6.1.3. The Maynard Reservoir radiocarbon dates are presented separately in Section 6.1.4. A discussion and summary of the temporal data is presented in Section 6.2. The second part of this chapter addresses Aim B: to examine the post-death taphonomic histories of the assemblages. The results and discussion are presented for the River Thames assemblage in Section 6.3, and for the Maynard Reservoir assemblage in Section 6.4.

6.1 Chronology results

6.1.1 The new radiocarbon dating programme

The radiocarbon dates obtained for 32 individuals as part of the new dating programme (see Section 4.2.1) are presented in Table 6.1 below. All individuals belonged to the River Thames assemblage, apart from SK 4191 from the Maynard Reservoir assemblage (see Section 4.2.1.1 for the reasons behind the inclusion of this individual). The radiocarbon data is presented in full in Appendix Table A.1. All samples had good collagen preservation as indicated by collagen yield, C:N ratios, %C and %N (DeNiro, 1985; Ambrose, 1990). The associated $\delta^{13}C$ and $\delta^{15}N$ isotope values indicated mainly terrestrial diets, with no need for marine or freshwater corrections.

The new radiocarbon dates for the two individuals (SK 4062, SK 1507) initially dated by Bradley and Gordon (1988), are consistent with the initial dates but with narrower calibrated date ranges (Table 6.2). The new dates for these individuals (GrM lab IDs) are carried forward throughout the thesis.

SK ID	Location	Element dated	Lab ID (GrM-)	^{14}C Age (yrBP)	cal BC/AD (95% confidence)		C:N	δ^{13}C	δ^{15}N
SK 19	Crossness	Calvarium	16893	4795 ± 25	-3640	-3525	3.4	-20.91	10.26
SK 4162	Northfleet	Calvarium	16906	4115 ± 20	-2860	-2575	3.3	-22.25	10.45
SK 4167	Battersea	Calvarium	16891	3040 ± 20	-1395	-1220	3.3	-20.81	10.43
SK 1522	Battersea	Cranium	16904	2985 ± 20	-1280	-1120	3.3	-20.34	9.79
SK 4105	Mortlake	Mandible	16903	2980 ± 20	-1275	-1120	3.3	-20.46	10.52
SK 4191	Maynard Reservoir	Cranium	16907	2940 ± 20	-1220	-1055	3.2	-20.81	10.49
SK 4062	Kew	Cranium	16998	2920 ± 25	-1215	-1015	3.2	-20.94	10.02
UNR EG 1414	Battersea	Cranium	16838	2905 ± 20	-1200	-1010	3.2	-20.66	10.17
SK 4067	Kew	Cranium	16911	2895 ± 20	-1195	-1005	3.3	-20.15	10.54
SK 1507	Mortlake Reach	Cranium	16851	2795 ± 20	-1015	-860	3.2	-19.64	9.82
SK 4084	Mortlake	Calotte	16909	2760 ± 20	-980	-830	3.3	-20.34	11.81
SK 4073	Mortlake	Calvarium	16850	2750 ± 20	-970	-825	3.2	-19.88	10.72
SK 1516	Battersea Bridge	Cranium	16899	2460 ± 20	-755	-420	3.2	-20.14	11.01
SK 1506	Mortlake Reach	Calvarium	16905	2420 ± 20	-730	-405	3.3	-20.28	11.14
SK 4092	Mortlake	Mandible	16898	2375 ± 20	-520	-390	3.3	-20.80	11.39
SK 1514	Chelsea Bridge	Cranium	16846	2285 ± 20	-400	-230	3.2	-20.02	8.67
SK 1526	Northfleet	Mandible	16841	2050 ± 20	-150	25	3.2	-19.77	11.80
SK 4055	Kew	Cranium	16997	2045 ± 25	-150	55	3.3	-20.91	12.09

SK ID	Location	Element dated	Lab ID (GrM-)	^{14}C Age (yrBP)	cal BC/AD (95% confidence)		C:N	$\delta^{13}C$	$\delta^{15}N$
SK 1558	Waterloo	Cranium	16843	2015 ± 20	-50	65	3.2	-19.99	11.46
SK 4130	Robiamors Dock	Cranium	16894	1935 ± 20	20	205	3.3	-18.78	11.14
SK 1518	Battersea Bridge	Cranium	16849	1915 ± 20	65	210	3.2	-19.62	8.94
SK 4137	Deptford	Calvarium	16890	1895 ± 20	80	215	3.3	-19.19	12.89
SK 1551	Whitehall Steps	Cranium	16837	1290 ± 20	665	775	3.2	-20.29	10.34
SK 139	Millbank	Cranium	16842	1114 ± 19	890	995	3.2	-19.58	8.78
E213	Hampton	Calvarium	16892	912 ± 19	1040	1210	3.2	-20.09	12.45
SK 4179	Waterloo Bridge	Mandible	16847	402 ± 19	1440	1615	3.2	-18.99	12.69
SK 4119	Pimlico	Cranium	16897	277 ± 18	1520	1665	3.2	-20.14	10.75
SK 4178	Greenwich	Cranium	16908	249 ± 19	1530	1800	3.3	-19.71	10.91
SK 1523	Somerset House	Cranium	16836	247 ± 19	1530	1800	3.2	-18.97	12.47
SK 1524	Tower	Calotte	16844	235 ± 20	1635	1800	3.2	-19.27	12.37
SK 1549	Poplar	Cranium	16845	242 ± 19	1635	1800	3.2	-18.08	13.11
SK 1563	Blackwall Tunnel	Mandible	16896	151 ± 18	1665	1910	3.2	-19.21	11.35

Table 6.1: The new radiocarbon determinations produced for the individuals in the River Thames and Maynard Reservoir assemblages in this thesis. The calibrated date ranges (95% confidence level) were calculated from the conventional radiocarbon age (years BP) using the IntCAL20 atmospheric calibration curve (Reimer et al., 2020) and OxCAL v4.4.1 software (Bronk Ramsey, 2009). The calibrated date ranges are quoted with the end points rounded outwards to five years, following the recommendations of Mook (1986) and Bayliss et al. (2008). Radiocarbon data is provided in full in Appendix Table A.1.

SK ID	Location	Lab ID	^{14}C Age (yrBP)	cal BC (95% confidence)	
SK 4062	Kew	OxA-1197	2910 ± 60	-1280	-920
		GrM-16998	2920 ± 25	-1215	-1015
SK 1507	Mortlake	OxA-1195	2740 ± 60	-1050	-790
		GrM-16851	2795 ± 20	-1015	-860

Table 6.2: The original (OxA IDs) and new (GrM IDs) radiocarbon dates for individuals SK 4062 and SK 1507.

6.1.2 The River Thames assemblage overall temporal dataset

The full temporal dataset for the River Thames assemblage is presented in Appendix Table A.1. The temporal dataset is presented by time period and dating project in Figure 6.1 and Figure 6.2 presents the approximate date range for each individual in calendar years.

The overall River Thames assemblage temporal dataset is comprised of 62 individuals: 31 of which were radiocarbon dated in the new programme and 33 of which were dated externally to the current project. The majority of individuals have been radiocarbon dated: 57 through direct dating of bone collagen and three through dating of an associated burial context (Yabsley 1 burial, and Bull Wharf Burials 1 & 2). Two individuals have been assigned a relative date on the basis of their associated footwear (CC188 1 from Cyclops Wharf, and Chambers 1 from Chambers Wharf). With regard to recovery circumstances and context, the majority (34 individuals) are remains without known context and recovered, or probably recovered, through historical dredging practices. However, limited context is available for some of these remains (e.g., SK 4105, a mandible from Mortlake found "below river bed with flint celts"), and this is outlined where appropriate in the time period overviews below.

The overall temporal dataset is presented by time period in the subsequent sections (Sections 6.1.2.1-6).

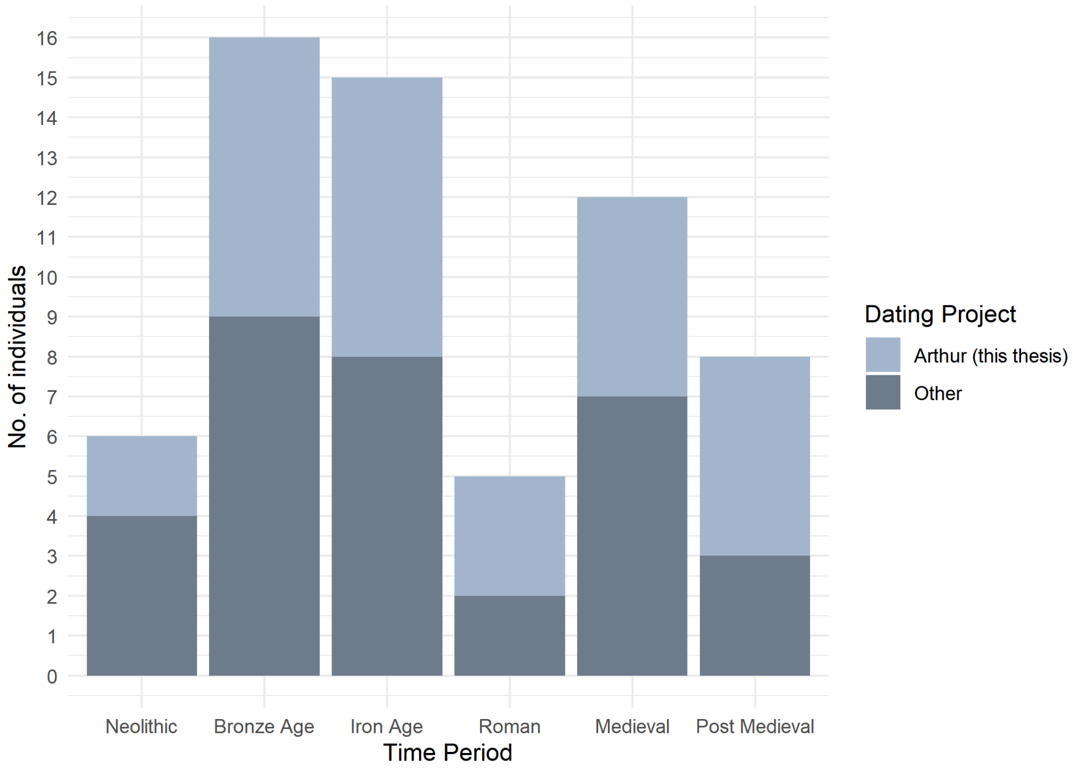

Figure 6.1: The overall River Thames assemblage temporal dataset, grouped according to time period and dating project. “Arthur (this thesis)” (light blue) are the new radiocarbon dates (GrM numbers), and “Other” (dark blue) are the human remains dated externally to the current project.

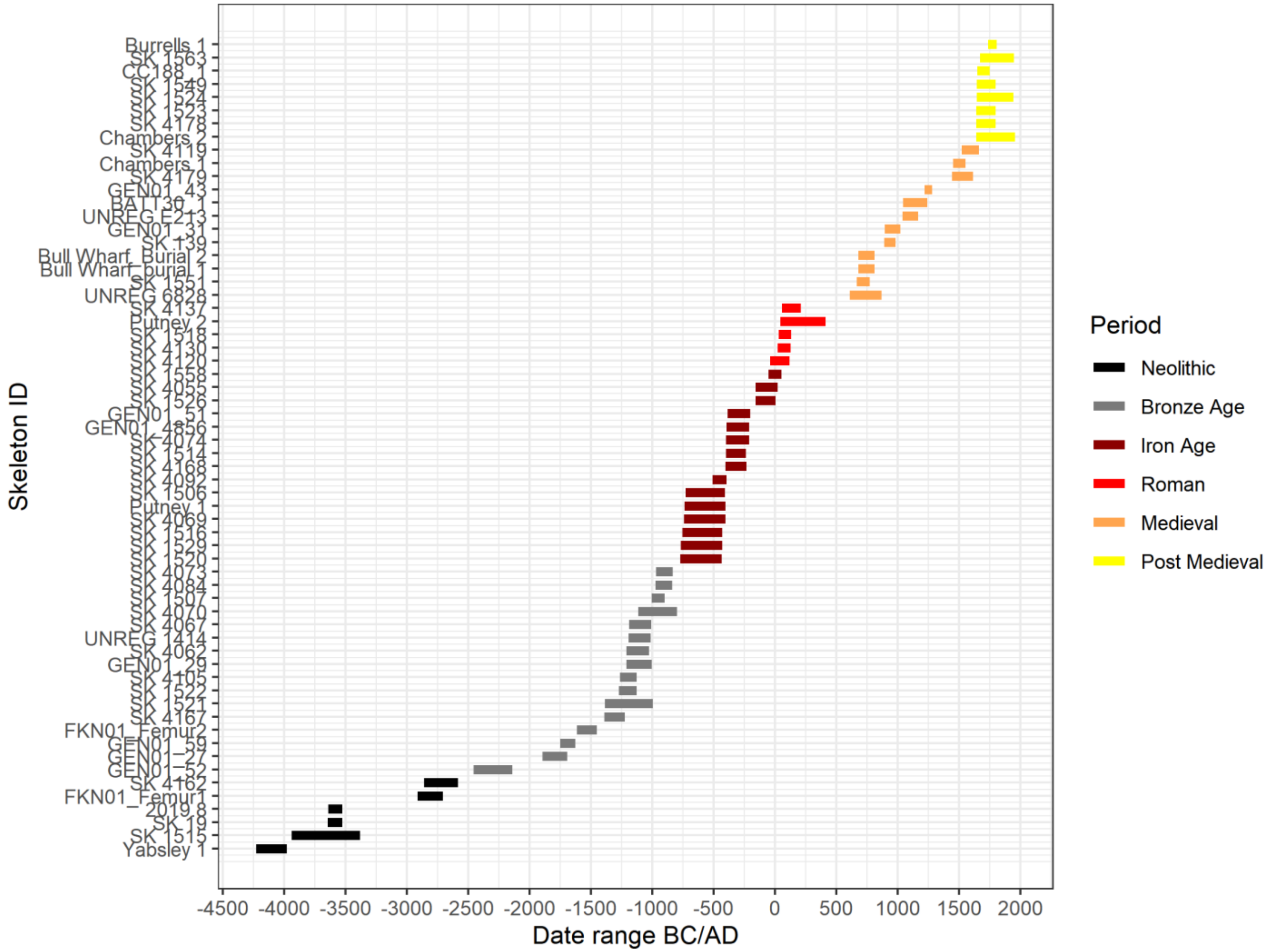

Figure 6.2: Date ranges for the River Thames assemblage, colour-coded according to time period. Black = Neolithic, grey= Bronze Age, dark red= Iron Age, light red= Roman, orange= Medieval, yellow= Post-Medieval.

6.1.2.1 The Neolithic (c. 4000-2300 BC)

Six of the River Thames assemblage individuals are of Neolithic date (see Table 6.3). These are geographically well dispersed along the river, ranging from Putney in the west to Crossness and Northfleet in the Thames Estuary. The earliest in date of these is a burial excavated from former Thames foreshore deposits at Yabsley Street in Blackwall, radiocarbon dated to 4230-3970 cal BC (Coles et al., 2008). Of the remaining Neolithic individuals, three were dredged or probably dredged, and two were foreshore finds. FKN01 Femur 1, a left femur dated 2920-2700 cal BC, was recovered from the foreshore at Chelsea either during Thames Archaeology Survey activities in the 1990s, or in a 2006 survey by Museum of London Archaeology (Edwards et al., 2009:45). At Putney, an isolated subadult frontal bone (2019.8) was recovered from the foreshore at low tide by a Mudlark in 2018, and was subsequently radiocarbon dated to 3645-3525 cal BC.

SK ID	Location	Element dated	Lab ID	cal BC (95% confidence)		Recovery	Context
Yabsley 1	Yabsley Street	Burial context	KIA20157	-4230	-3980	Archaeological excavation (2000s)	Skeleton- burial on former foreshore (see Coles et al., 2008)
SK 1515	Battersea Bridge	Cranium	OxA-1199	-3950	-3380	Probably dredged	Unknown
2019.8	Putney	Frontal bone	SUERC-82512	-3640	-3520	Foreshore find (2018)	Isolated remains on foreshore
SK 19	Crossness	Calvarium	GrM-16893	-3640	-3525	Probably dredged	Unknown
FKN01 Femur1	Chelsea	Left femur	OxA-20589	-2920	-2700	Foreshore surface find (1990s or 2006)	Isolated remains on foreshore
SK 4162	Northfleet	Calvarium	GrM-16906	-2860	-2575	Dredged (1915)	Unknown

Table 6.3: The River Thames individuals radiocarbon dated to the Neolithic period. Full radiocarbon data is available in Appendix Table A.1. Lab IDs prefixed “GrM” were generated for the current project.

6.1.2.2 The Bronze Age (c. 2300-800 BC)

The Bronze Age is the best represented time period within the temporal dataset. A total of 16 Bronze Age individuals have been identified; seven of which were identified for the first time in the new programme of radiocarbon dating. The majority of the Bronze Age individuals are of Late Bronze Age date, with 11 individuals falling between 1200 and 800 cal BC (see Table 6.4 and Figure 6.3). There appears to be particularly strong clustering around 1200-1100 cal BC: 1150 cal BC falls within the calibrated date range (at 95% confidence) of nine individuals (Figure 6.3). All are disarticulated remains, and the majority (13 individuals) were recovered through dredging or probable dredging. Two individuals, GEN01 59 and FKN01 Femur 2, were recovered recently from the Chelsea foreshore. Two of the Late Bronze Age individuals have alleged artefact associations: SK 4105, a mandible from Mortlake dated 1265-1125 cal BC, was apparently “below river bed with flint celts”; and SK 1507, a cranium also from Mortlake dated 1005-900 cal BC was noted to have come from “a stratum underlying Bronze Age implements”.

SK ID	Location	Element dated	Lab ID	cal BC (95% confidence)		Recovery	Context
Early Bronze Age c. 2300-1600 BC							
GEN01 52	Syon Reach	Calvarium	OxA-14728	-2460	-2140	Archaeological excavation?	Found on site of pile dwelling
GEN01 27	Mortlake	Cranium	OxA-14731	-1900	-1690	Probably dredged	Unknown
GEN01 59	Chelsea	Calotte	OxA-11086 + 7	-1870	-1610	Found on foreshore during a survey in 2001	Isolated remains on foreshore, partially embedded in Neolithic forest remains (see Edwards et al., 2009)
Middle Bronze Age c. 1600-1200 BC							
FKN01 Femur2	Chelsea	Left femur	OxA-20511	-1620	-1440	Foreshore surface find (1990s or 2006)	Isolated remains on foreshore
SK 4167	Battersea	Calvarium	GrM-16891	-1395	-1220	Probably dredged	Thames alluvium, 17ft

SK ID	Location	Element dated	Lab ID	cal BC (95% confidence)		Recovery	Context
Late Bronze Age c. 1200-800 BC							
SK 1521	Battersea/ Vauxhall Bridge	Cranium	OxA-1198	-1390	-990	Dredged 1863	Unknown
SK 1522	Battersea	Cranium	GrM-16904	-1280	-1120	Dredged (pre-1867)	Unknown
SK 4105	Mortlake	Mandible	GrM-16903	-1275	-1120	Probably dredged	Below river bed with flint celts
GEN01 29	Mortlake	Cranium	OxA-14765	-1220	-1000	Probably dredged 1914	Unknown
SK 4062	Kew	Cranium	GrM-16998	-1215	-1015	Dredged (pre-1890)	From layer of coarse black gravel, encrusted with lime, above London clay.
			OxA-1197	-1280	-920		
UNRE G 1414	Battersea	Cranium	GrM-16838	-1200	-1010	Probably dredged	Unknown
SK 4067	Kew	Cranium	GrM-16911	-1195	-1005	Dredged (pre-1890)	From layer of coarse black gravel, encrusted with lime, above London clay.
SK 4070	Mortlake	Calvarium	OxA-1196	-1120	-790	Dredged	Unknown
SK 1507	Mortlake Reach	Cranium	GrM-16851	-1015	-860	Probably dredged (pre-1910)	From the bed of the Thames- a stratum underlying Bronze Age implements
			OxA-1195	-1050	-790		
SK 4084	Mortlake	Calotte	GrM-16909	-980	-830	Probably dredged	Unknown
SK 4073	Mortlake	Calvarium	GrM-16850	-970	-825	Probably dredged 1906	From peat of Thames at Mortlake

Table 6.4: The River Thames individuals radiocarbon dated to the Bronze Age. Full radiocarbon data is available in Appendix Table A.1. Lab IDs prefixed “GrM” were generated for the current project.

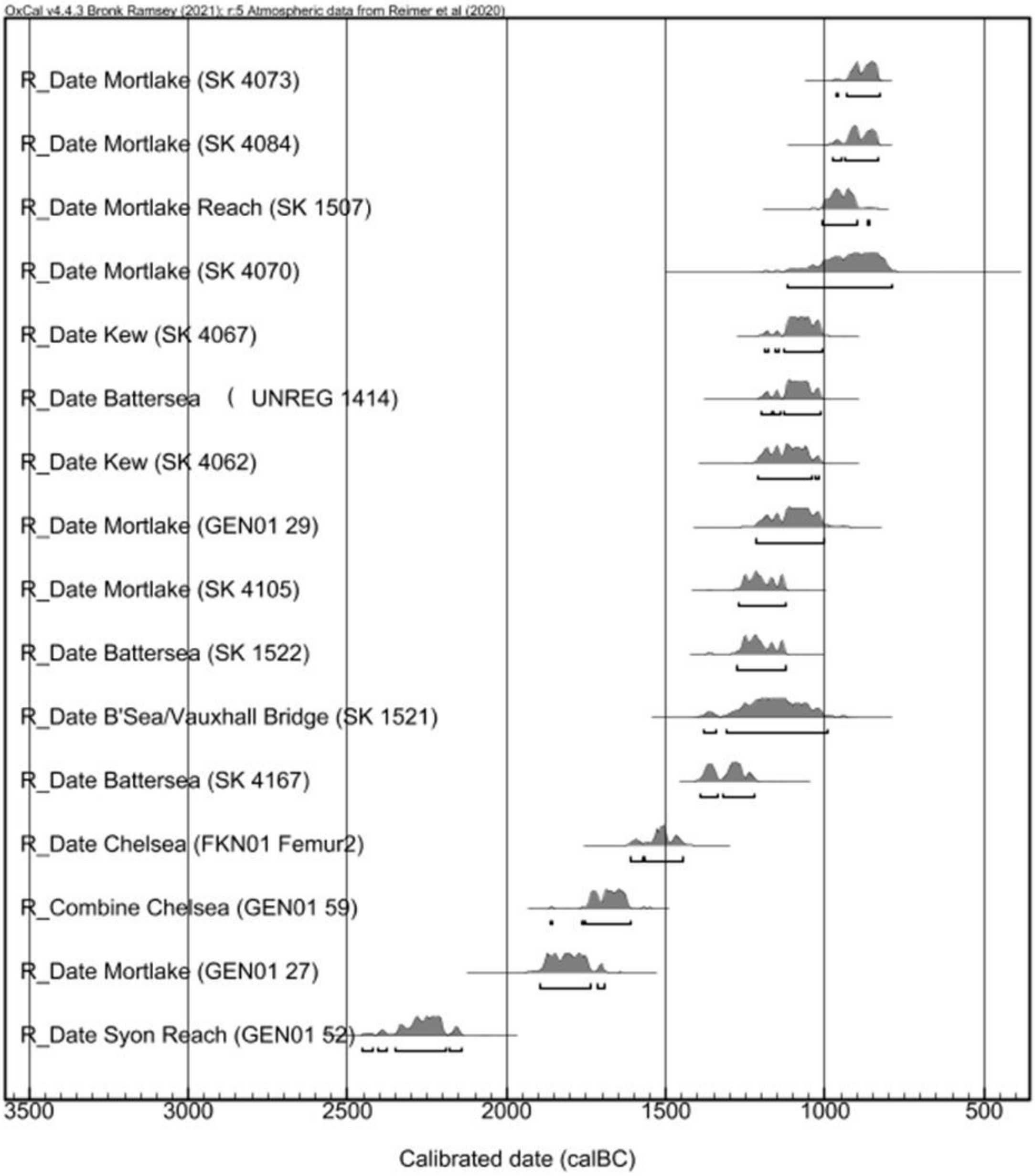

Figure 6.3: The calibrated radiocarbon dates for all Bronze Age River Thames individuals.

6.1.2.3 The Iron Age (c. 800 BC- AD 43)

The Iron Age is the second best-represented time period for the River Thames assemblage with 15 individuals, seven of which were identified for the first time in the new programme of radiocarbon dating (see Figure 6.1 and Table 6.5.). The concentration of individuals decreases throughout the Iron Age: seven individuals belong to the Early Iron Age, five to the Middle Iron Age, and three to the Late Iron Age (Table 6.5, Figure 6.4). All 15 individuals were disarticulated remains and the majority, 10 individuals, were recovered through dredging or probable dredging (Table 6.5). Three individuals, Putney 1, GEN01 4856 and GEN01 51, are recent surface finds from the Putney foreshore (Table 6.5).

SK ID	**Location**	**Element dated**	**Lab ID**	**cal BC (95% confidence)**		**Recovery**	**Context**
Early Iron Age c. 800-400 BC							
SK 1520	Battersea Bridge	Cranium	OxA-18775	-770	-420	Probably dredged (pre-1867)	Unknown
SK 1529	Thames	Cranium	OxA-18777	-770	-420	Probably dredged (pre-1922)	Unknown
SK 1516	Battersea Bridge	Cranium	GrM-16899	-755	-420	Probably dredged (pre-1867)	Unknown
SK 4069	Mortlake	Cranium	OxA-18778	-750	-400	Probably dredged	Thames alluvium Mortlake
Putney 1	Putney	Mandible	SUERC-82794	-750	-400	Foreshore surface find (2018)	Isolated remains, from foreshore surface at low tide
SK 1506	Mortlake Reach	Calvarium	GrM-16905	-730	-405	Dredged (pre-1910)	From a layer of clay under a firm stratum of gravel
SK 4092	Mortlake	Mandible	GrM-16898	-520	-390	Probably dredged	From deep ballast
Middle Iron Age c. 400-100 BC							
SK 4168	Battersea	Calotte	OxA-18776	-410	-210	Probably dredged	Thames alluvium Battersea
SK 1514	Chelsea Bridge	Cranium	GrM-16846	-400	-230	Dredged (pre-1880)	Unknown

GEN01 4856	Putney	Frontal bone	SUERC-54048	-400	-200	Foreshore find (2014)	Isolated remains, found on foreshore surface
SK 4074	Mortlake	Calvarium	OxA-18779	-400	-200	Dredged ("08")	Alluvium
GEN01 51	Putney	Calotte	OxA-14730	-390	-200	Foreshore surface find (2003)	Isolated remains, found on foreshore surface. In a "black –grey silty sand deposit" (see Cotton and Green, 2004)
Late Iron Age c. 100 BC – AD 43							
SK 1526	Northfleet	Mandible (maxilla)	GrM-16841	-150	25	Unknown "found in the mud of the Thames Estuary at Northfleet" (pre 1918)	Unknown
SK 4055	Kew	Cranium	GrM-16997	-150	55	Dredged (pre-1890)	From layer of coarse black gravel, encrusted with lime, immediately above London clay (see Lawrence, 1891)
SK 1558	Waterloo	Cranium	GrM-16843	-50	65	Found during excavations for construction near Waterloo Station	Found in the blue clay at 16ft

Table 6.5: The River Thames individuals radiocarbon dated to the Iron Age. Full radiocarbon data is available in Appendix Table A.1. Lab IDs prefixed "GrM" were generated for the current project.

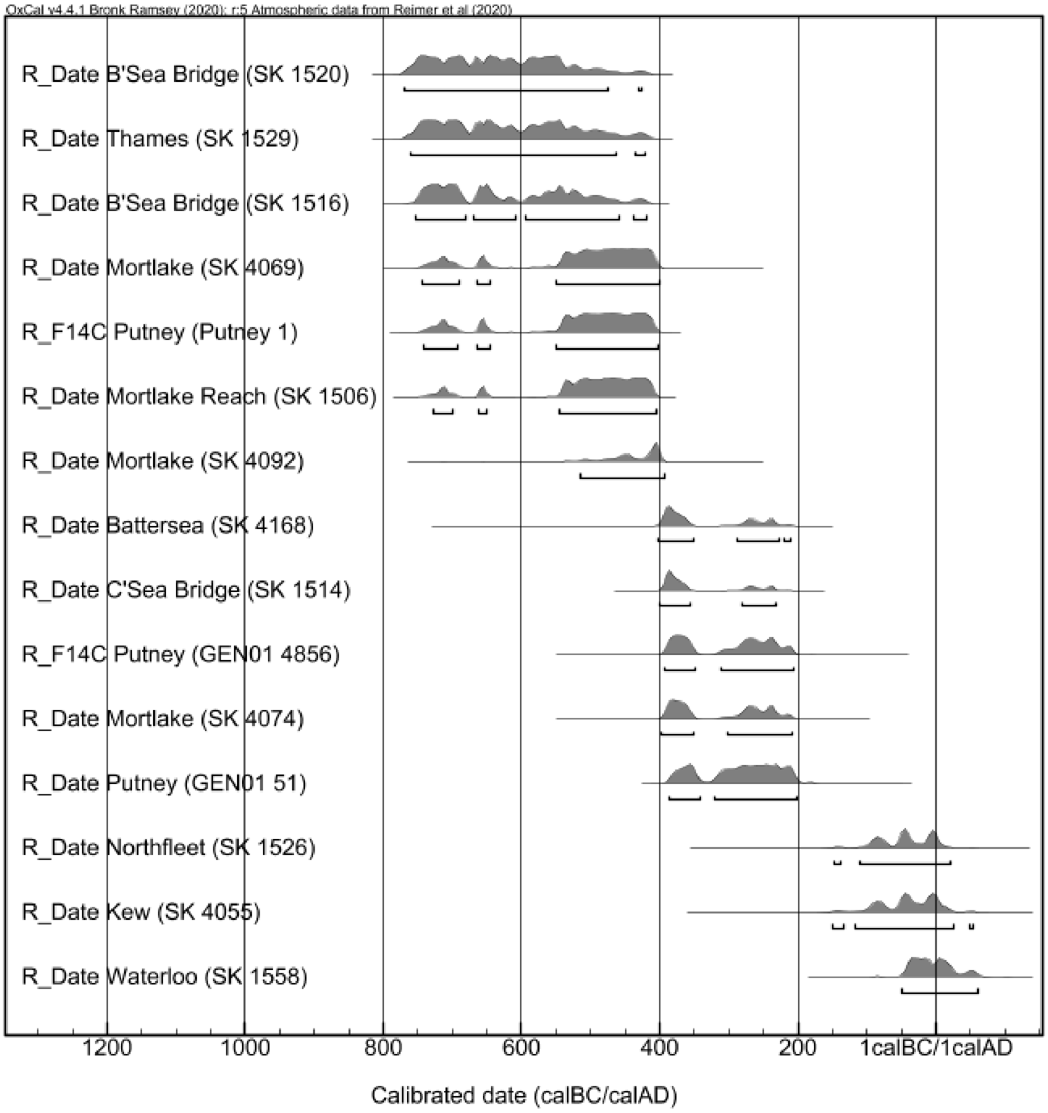

Figure 6.4: The calibrated radiocarbon dates for all Iron Age River Thames individuals.

6.1.2.4 The Roman period (c. AD 43-410)

Five individuals from the River Thames assemblage have been radiocarbon dated to the Roman period, three of which were identified for the first time in the new programme of radiocarbon dating (Table 6.6). However, Putney 2, a mandible found on the foreshore at Putney in 2014, is only tentatively included. In correspondence with the finders it was reported that the mandible was radiocarbon dated, and the date was returned as Roman, however the radiocarbon documentation cannot be located. Photographs do exist of the mandible in situ on the foreshore.

SK ID	Location	Element dated	Lab ID	cal BC/AD (95% confidence)		Recovery	Context
SK 4120	Wandsworth	Calvarium	OxA-18780	-40	130	Probably dredged (pre 1911)	Thames alluvium
SK 4130	Robiamors Dry Dock, Limehouse	Cranium	GrM-16894	20	205	Probably construction	From alluvium, found in the ballast 5ft with cranium, Bos. Frontosus
SK 1518	Battersea Bridge	Cranium	GrM-16849	65	210	Probably dredged (pre-1867)	Unknown
SK 4137	Deptford	Calvarium	GrM-16890	80	215	Unknown- found at Deptford	From the Mayer or Maxer Collection with Jet necklace now in Guildhall Museum.
Putney 2	Putney	Mandible	Unknown	X	X	Foreshore find (2014)	Isolated remains, found on foreshore surface. Radiocarbon dated and reported as “Roman”, but documentation missing. Photographs exist however.

Table 6.6: The River Thames individuals radiocarbon dated to the Roman period. Full radiocarbon data is available in Appendix Table A.1. Lab IDs prefixed “GrM” were generated for the current project.

6.1.2.5 The Medieval period (c. AD 410-1540)

Eleven individuals in the River Thames assemblage have been radiocarbon dated to the Medieval period, five of which were identified for the first time in the new programme of radiocarbon dating (Table 6.7). Six of these belong to the earlier Medieval period, prior to the Norman conquest of AD 1066, and five belong to the later half (Table 6.7). There is an apparent approximate 400 year gap in the temporal span of the River Thames assemblage, with no remains dated to between AD 200 and AD 600 (Table 6.7). The recovery method and burial contexts are more varied than for remains of the preceding periods. Seven individuals are represented by disarticulated remains, and three by partial/complete skeletons (Table 6.7). Five individuals (all disarticulated remains) were recovered through dredging or probable dredging, four

through construction work, and two (the Bull Wharf burials) through archaeological excavation (see Ayre and Wroe-Brown, 2015) (Table 6.7).

Bull Wharf Burials 1 and 2 are complete inhumation burials recovered from foreshore deposits at Bull Wharf (Ayre and Wroe-Brown, 2015). Burial 1 was radiocarbon dated to cal AD 680-810 through dating of associated pieces of bark, and Burial 2 is considered to be almost certainly contemporaneous owing to their close proximity and similarity (Ayre and Wroe-Brown, 2015). SK 139 is a partial skeleton recovered in 1929 during construction works about 30 metres from the bank of the River Thames at Millbank (Tildesley, 1931).

SK ID	**Location**	**Element dated (associated elements)**	**Lab ID**	**cal AD (95% confidence)**		**Recovery**	**Context**
UNREG 6828	Battersea	Cranium	OxA-1191	600	880	Probably dredged	Unknown
SK 1551	Whitehall Steps	Cranium (skull)	GrM-16837	665	775	Construction	Skull found during drain digging. Two other skulls and many loose bones were found in the same spot.
Burial 1	Bull Wharf	Burial context	See Table XX	680	810	Archaeological excavation	Complete burial on former foreshore surface
Burial 2	Bull Wharf	Burial context of associated burial (Burial 1)	NA	NA	NA	Archaeological excavation	Complete burial on former foreshore surface. Burials 1 and 2 are considered by Ayre and Wroe-Brown (2008:160) to be contemporaneous.
GEN0131	Kew	Cranium	OxA-14729	890	1030	Probably dredged	Unknown

SK 139	Millbank	Cranium (partial skeleton)	GrM-16842	890	995	Construction close to riverbank (1929)	Partial skeleton. Found at 13-14ft depth, in layer of muddy blue clay overlying peat. Skeleton lying contracted on left side (see Tildesley, 1931)
E 213	Hampton	Calvarium	GrM-16892	1040	1210	Probable dredging. Recovered from filter beds, island in Thames at Hampton	Unknown
BATT301	Battersea Power Station	Cranium	SUERC-52875	1040	1260	Found buried 4m below the bed of the Thames during excavations for the water inlet pipes to B'Sea pwr st	Unknown
GEN0143	High Bridge, Barn Elms	Cranium	OxA-14727	1220	1280	Probably dredged (pre-1918)	Unknown- found with mandible? (Edwards et al., 2008)
SK 4179	Waterloo Bridge	Mandible	GrM-16847	1440	1615	Found in construction work beneath Institute of Electrical Engineers, near the river bank (May 1960)	Found in layer of silt and clay. Associated bones include pig, sheep or goat, and ox.
SK 4119	Pimlico	Cranium	GrM-16897	1520	1665	Probably dredged	Thames alluvium

Table 6.7: The River Thames individuals radiocarbon dated to the Medieval period. Full radiocarbon data is available in Appendix Table A.1. Lab IDs prefixed "GrM" were generated for the current project.

6.1.2.6 The Post-Medieval period (c. AD 1540- 1901)

Nine individuals in the River Thames assemblage have been dated to the Post-Medieval period, five of which were identified in the new programme of radiocarbon dating (Table 6.8). Five of these are articulated skeletons, and four have been recovered from the present-day foreshore.

SK ID	Location	Element dated (associated elements)	Lab ID	cal AD (95% confidence)		Recovery	Context/ Notes
Chamb-ers 2	Chambers Wharf	Scapula (partial skeleton)	OxA-11141–2	1640	1955	Recovered from foreshore surface in Feb 2002	Partial articulated skeleton found eroding from foreshore (see Bayliss et al., 2004)
SK 4178	Greenwich	Cranium (partial skeleton)	GrM-16908	1530	1800	Unknown	Partial articulated skeleton, from Greenwich, Thames
SK 1523	Somerset House	Cranium	GrM-16836	1530	1800	Dredged from the Thames near Somerset House, 1865	Unknown
SK 1549	Poplar	Cranium	GrM-16845	1635	1800	Construction- found while digging the foundations of a building in Poplar, near the river bank	Unknown
SK 1524	Tower	Calotte	GrM-16844	1635	1800	Dredged in April 1854 by the Samson dredger, which was working on a shelf which had grown up near the Government Stores of the Tower Wharf, just above Traitor's Gate	Embedded in 4ft to 5ft of mixed clay and gravel
SK 1563A	Blackwall Tunnel	Mandible (skull?)	GrM-16896	1665	1910	Construction- skull found in excavating the bed of the Thames to form the Blackwall Tunnel near the South bank	Unknown- “depth etc not recorded”
Burrells 1	Burrells Wharf	Cranium (skeleton)	OxA-21181-2	1650	1920	Excavated from foreshore April 2009-Jan 2010	No details reported (see Cohen et al., 2013)

Chamb-ers 1	Chambers Wharf	Articulated skeleton	NA	NA	NA	Excavated from former foreshore deposits. Found in prone position	Relative date: late C15th-early C16th AD (MOLAHeadland, 2018)
CC188	Cyclops Wharf	Articulated skeleton	NA	NA	NA	Excavated from former foreshore deposits	Relative date: late C17th-early C18th AD (Williams, 1988)

Table 6.8: The River Thames individuals radiocarbon dated to the Post-Medieval period. Full radiocarbon data is available in Appendix Table A.1. Lab IDs prefixed "GrM" were generated for the current project.

6.1.3 Spatial patterning in the Thames assemblage temporal dataset

The overall spatial patterning in the River Thames assemblage temporal dataset is presented visually in Figure 6.5, and by Thames zone in Table 6.9. There is a general tendency for the Bronze and Iron Age individuals to be located in the more westerly zones of the river. For example, of the 16 individuals of Bronze Age date, none are located further east than Battersea, despite a high proportion of individuals in the more easterly zones (F-H) being dated (Table 6.9). Of the 15 individuals radiocarbon dated to the Iron Age, 13 are located in Battersea or further west (Table 6.9). By contrast, the later, Medieval and Post-Medieval individuals are distributed more towards the central and eastern zones, with Post-Medieval individuals at present being limited to central London (zone F) and the Isle of Dogs (zone G) (Table 6.9). The highest numbers of undated individuals either have a general Thames location (73 individuals), or are located in the more westerly zones (B, C, D) (Table 6.9).

There does not appear to be any particularly strong spatial patterning within any of the single locations from which multiple individuals are present (see Figure 6.5). This is perhaps unsurprising given the limitations of the spatial data (see Section 5.1.2.1) and the unknown recovery circumstances (e.g., were the remains recovered from the same, or different, campaigns of dredging, and at the same, or different depths). However, of the nine elements recovered from the foreshore surface at Putney in recent years (see Figure 5.6) five have been radiocarbon dated, and have a slight Iron Age bias: three were Iron Age (Putney 1, GEN01 4856, GEN01 51), one was Neolithic in date (2019.8) and one probably Roman (Putney 2). Furthermore at Mortlake, nine of the 50

individuals have now been radiocarbon dated, and all fall between the Middle Bronze and Middle Iron Ages (see Sections 6.1.2.2 and 6.1.2.3).

Thames zone	***n* individuals**	***n* dated**	**% dated**	**Period of affected individuals (*n*)**					
				NE	**BA**	**IA**	**R**	**M**	**PM**
A. West outliers	4	1	25.0%	-	-	-	-	1	-
B. Richmond-Kew	16	5	31.3%	-	3	1	-	1	-
C. Mortlake - H'smith	70	12	17.1%	-	7	4	-	1	-
D. Putney-W'worth	20	6	30.0%	1	-	3	2	-	-
E. Battersea/ Chelsea	18	15	83.3%	2	6	4	1	2	-
F. Central London	19	11	57.9%	-	-	1	-	6	4
G. Isle of Dogs	12	8	66.7%	1	-	-	2	-	5
H. East Outliers	4	3	75.0%	2	-	1	-	-	-
Thames	74	1	1.4%	-	-	1	-	-	-
Total *n*	**237**	**62**	**26.2%**	**6**	**16**	**15**	**5**	**11**	**9**

Table 6.9: The spatial distribution of dated and undated individuals in the River Thames assemblage, presented according to Thames zone. See Section 4.1.1.2.4 and Figure 5.2 for description of Thames zones. The zones are labelled A to H, from the west to the east. The number of individuals in each zone is given (*n* individuals), alongside the number of individuals from that zone which have been dated (*n* dated), and the percentage of individuals from that zone which have been dated (% dated). The temporal distribution of the dated individuals within each zone is presented in the final column (Period of affected individuals (*n*)). "NE"= Neolithic, "BA"= Bronze Age, "IA"= Iron Age, "R"= Roman, "M"= Medieval, "PM"= Post-Medieval.

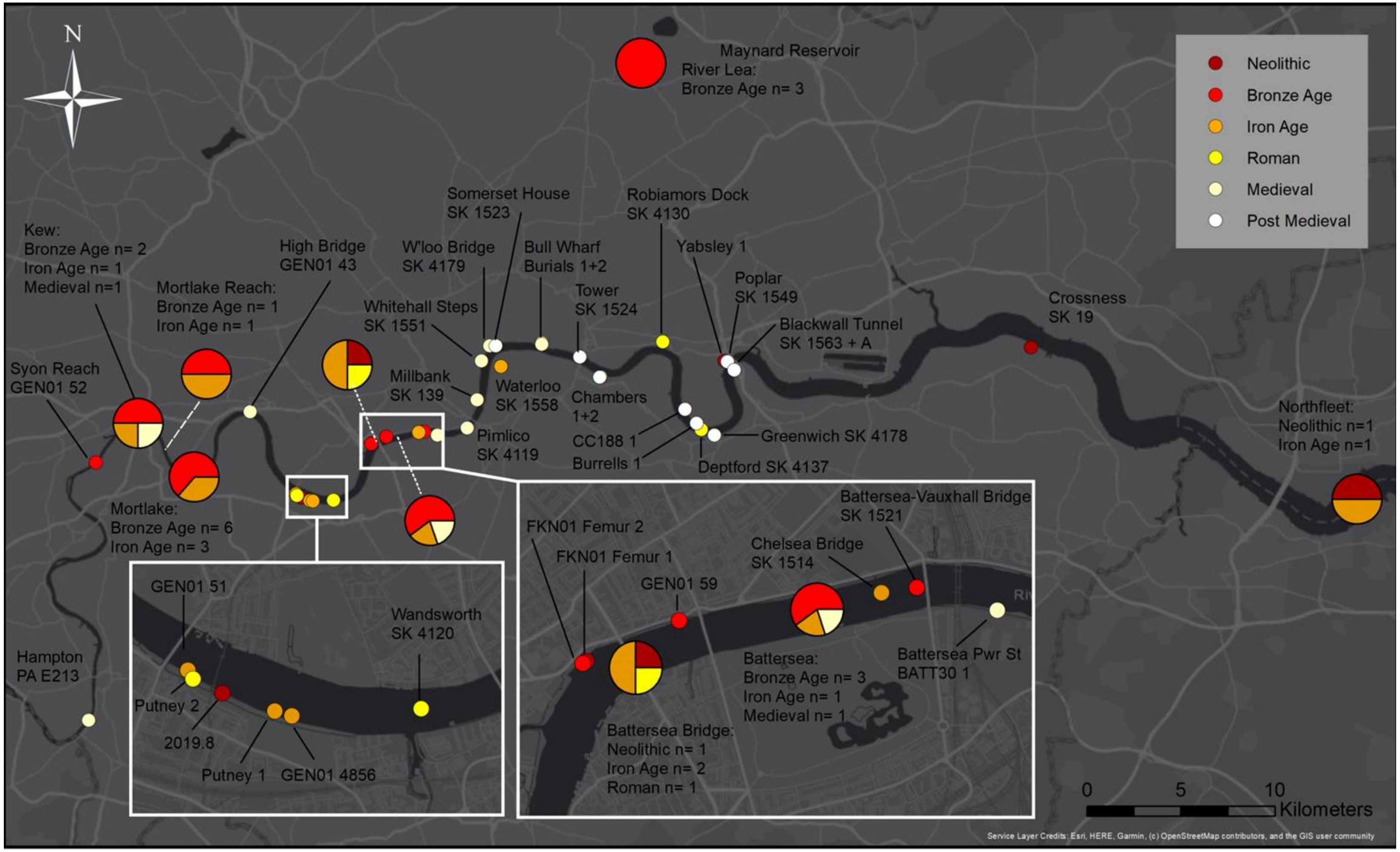

Figure 6.5: Map showing the recovery location and time period of individuals within the temporal dataset. Pie charts are given for locations where more than one individual is present.

6.1.4 Temporal patterning in the Maynard Reservoir assemblage

The three radiocarbon dates obtained for the Maynard Reservoir assemblage are presented in Table 6.10. Two radiocarbon dates had been provided previously by Schulting and Bradley (2013), for SK 4191A (a mandible) and SK 3311 (a cranium). As outlined in Section 4.2.1.1, the cranium SK 4191 was radiocarbon dated in the new programme of radiocarbon dating, as it did not articulate with mandible SK 4191A, and therefore represented a separate individual.

All three elements were of Late Bronze Age date, and ranged between 1380 and 900 cal BC. SK 4191A and SK 4191 were broadly contemporary with dates of 1380-1050 cal BC and 1220-1055 cal BC, respectively. However there were only 55 years of overlap (1110 to 1055 cal BC) between these individuals and cranium SK 3311, which was radiocarbon dated to 1110-900 cal BC.

SK ID	Location	Element dated	Lab ID	cal BC/AD (95% confidence)		Recovery	Context
SK 4191A	Maynard Reservoir	Mandible	OxA-18774	-1380	-1050	Reservoir construction 1868-9	Shell marl with wolf & beaver
SK 4191	Maynard Reservoir	Cranium	GrM-16907	-1220	-1055	Reservoir construction 1868-9	Shell marl with wolf & beaver
SK 3311	Maynard Reservoir	Cranium	OxA-18773	-1110	-900	Reservoir construction 1868-9	Shell marl with wolf, beaver, red deer and goat

Table 6.10: The radiocarbon dates for the Maynard Reservoir assemblage individuals. Full radiocarbon data is available in Appendix Table A.1. Lab IDs prefixed “GrM” were generated for the current project.

6.2 Chronology discussion and summary

For the River Thames assemblage, the addition of the 31 new radiocarbon dates generated in this thesis (Section 6.1.1) has nearly doubled the number of dated individuals: 26.2% (62/237) of the assemblage now has associated temporal data. Interestingly, although the number of dates has significantly increased, the relative distribution of dated individuals across the major time periods has remained largely unchanged (Figure 6.1). There appears to be an overall bias towards individuals of Bronze Age date (Section 6.1.2.2), particularly Late Bronze Age, and Iron Age date (Section 6.1.2.3). This is in spite of the fact that the overall temporal dataset has been produced through a variety of avenues (e.g., some dated through various academic studies, others through the City and Greater London police forces, see Appendix Table A.1).

There appears to be a fairly strong degree of overall spatial patterning in the River Thames temporal dataset, with Bronze Age and Iron Age individuals concentrated mainly at and towards the west of Battersea/Chelsea (zone E, see Table 6.9), and Medieval and Post-Medieval individuals concentrated in the more central and eastern zones (F-H, see Table 6.9). On the basis of this patterning, it can be hypothesised that the majority of the remaining undated portion of the River Thames assemblage is perhaps likely to be predominantly Bronze Age, particularly Late Bronze Age, or Iron Age in date. This is because, of the remaining 175 undated individuals, most of these are concentrated in the more western zones (particularly zone C, 58 individuals), or are of general Thames location (73 individuals) (see Table 6.9). Even though the specific recovery location of the general Thames individuals is not known, it appeared from research into the collection history that they are likely to be from the western reaches, and potentially the area of Kew (see Section 5.1.3).

To summarise, with 26.2% (62/237) of the River Thames assemblage dated, it presents a bias towards individuals of Bronze Age, particularly Late Bronze Age, and Iron Age date. A large portion of the remaining undated individuals are also considered likely to be of a similar date. This finding broadly supports the previous observations of Schulting and Bradley (2013), and is contra to Knüsel and Carr (1995) who hypothesised that (although with a much smaller available dated sample) there was no evidence for such a temporal bias and the remaining undated individuals could have belonged to any time period (see Section 3.2.3.1).

With regard to the Maynard Reservoir assemblage, it is unclear on the basis of the current dating evidence whether the assemblage could have been formed in a single, or multiple, depositional episodes. Further radiocarbon dating of the human remains could enhance understandings of this, but may not be able to definitely resolve this question, particularly in light of the evidence for the curation of human remains in the Late Bronze Age, in which bones were intentionally retrieved and preserved for significant periods of time prior to deposition (e.g., Booth and Brück, 2020).

6.3 River Thames assemblage taphonomic histories

6.3.1 River Thames assemblage taphonomic histories results

6.3.1.1 Thames element representation

The elements present within the River Thames assemblage are presented in Figure 6.6, colour-coded according to time period. The bone types comprising each single skeletal element (e.g., mandible, femur etc) are shown separately. Cranial remains were classified either as a cranium, calvarium, calotte, or cranial fragment, based on completeness (see Section 4.3.2).

As already outlined in Section 5.1.1, the majority of the assemblage, 94.9% (225/237), was comprised of single skeletal elements. Ten articulated skeletons, and two articulated elements were also present. Within the single skeletal elements, cranial remains dominate, comprising 92.0% (207/225). Non-cranial bones are present however, represented by 13 mandibles and five post-cranial bones.

Assisted by the additional radiocarbon dates, it is possible to consider the presence of broad temporal patterns within the element representation. The articulated skeletons overwhelmingly belonged to the later, historic periods. Of the ten, nine have been dated: four were Medieval, four were Post-Medieval, and one was Neolithic (Figure 6.6). Of the two articulated elements, one was Medieval in date (SK 1551, a skull recovered near Whitehall steps) and one was Late Iron Age in date (SK 1526 from Northfleet, a skull recovered from Northfleet). With the exception of the Neolithic period, all time periods were represented among the six dated, isolated mandibular remains. The two Iron Age mandibles were recovered from Putney and Mortlake, and the Bronze Age mandible from Mortlake. Only two of the five post-cranial isolated elements have so far been dated (Figure 6.6). Both were femurs recovered from the

foreshore at Chelsea; one was Neolithic in date (FKN01 Femur 1), and one was Middle Bronze Age (FKN01 Femur 2).

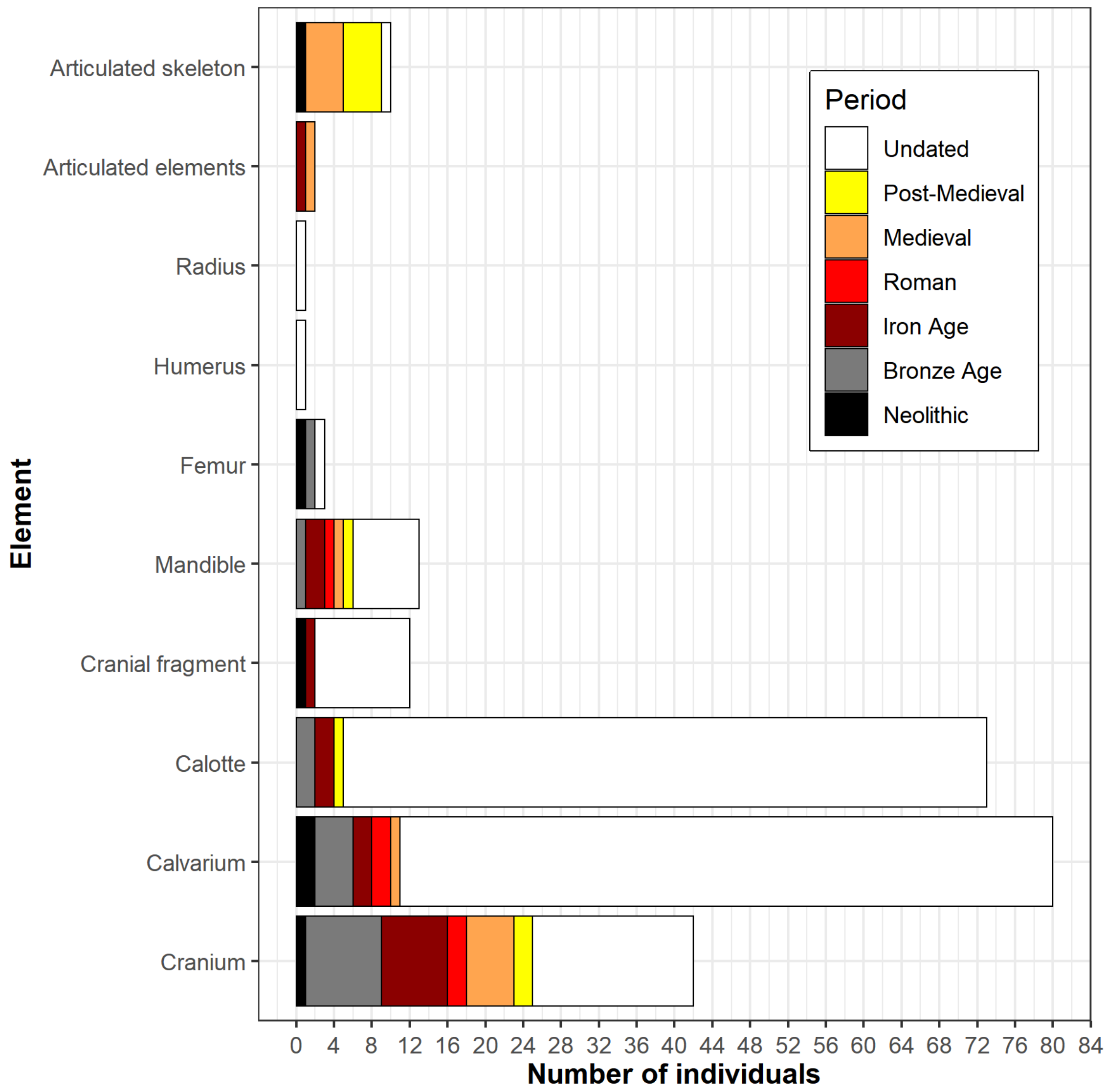

Figure 6.6: The element composition of the River Thames assemblage, colour-coded according to time period. The single skeletal elements are presented according to individual bone types (e.g., cranium, femur, mandible).

6.3.1.2 Fluvially-derived taphonomic changes

6.3.1.2.1 Loss of facial bones

Among the isolated cranial remains, the vast majority had lost the facial bones. Crania, defined by the retention of at least some facial bones (excluding the nasal bones), represented only 20.3% (42/207) of the isolated cranial remains. The less complete categories of cranial remains, missing the facial bones, were better represented. Calvaria represented 39.0% (80/205) of isolated cranial remains, and calottes 35.6% (73/205).

6.3.1.2.2 Abrasion

The River Thames assemblage presented a moderate degree of general abrasion, as indicated by McKinley (2004) abrasion grades (Figure 6.7). None of the 223 Thames remains which were osteologically examined presented the extremes of abrasion i.e., grade 0 (no abrasion) or grade 5+ (extreme penetrating abrasion). The majority of remains presented grade 3 (48.0%; 107/223), followed by grade 4 (25.1%; 56/223).

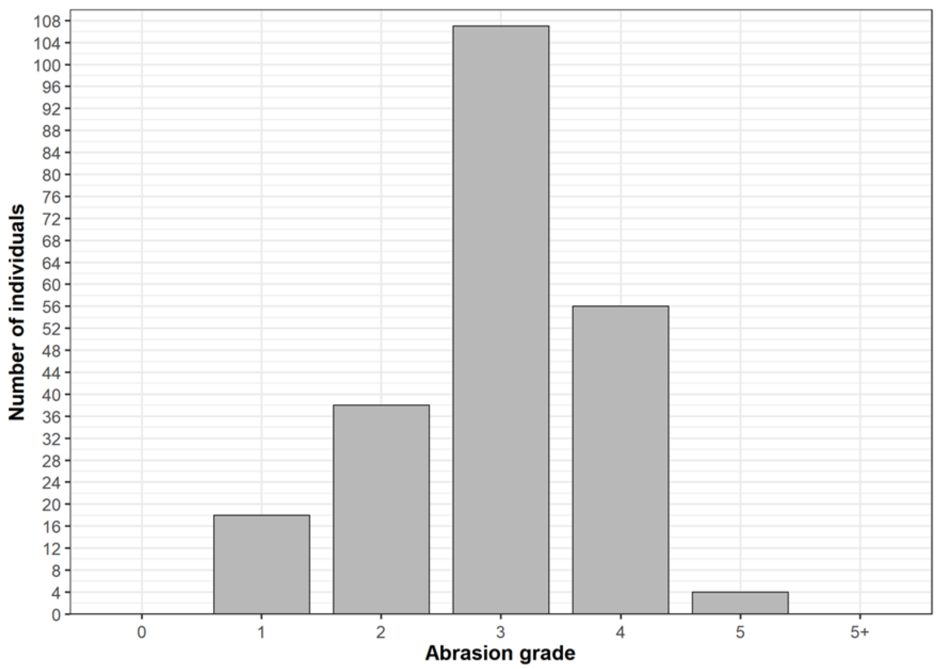

Figure 6.7: The distribution of McKinley (2004) abrasion grades in the Thames assemblage.

The abrasion scores are presented according to element type in Figure 6.8. There appears to be some relationship between level of completeness and severity of abrasion: 26.2% (11/42) of the crania presented abrasion grade 1, compared to only one of the 80 calvaria and none of the calottes. Grade 5, the most advanced level of abrasion recorded among the River Thames assemblage, was only present in the less complete calvaria and calottes.

Where observable, some degree of polishing was observable on all but one of the elements. Polishing was present on 90.6% (202/223) of elements, absent on 0.4% (1/223), and unobservable on 9.0% (20/223).

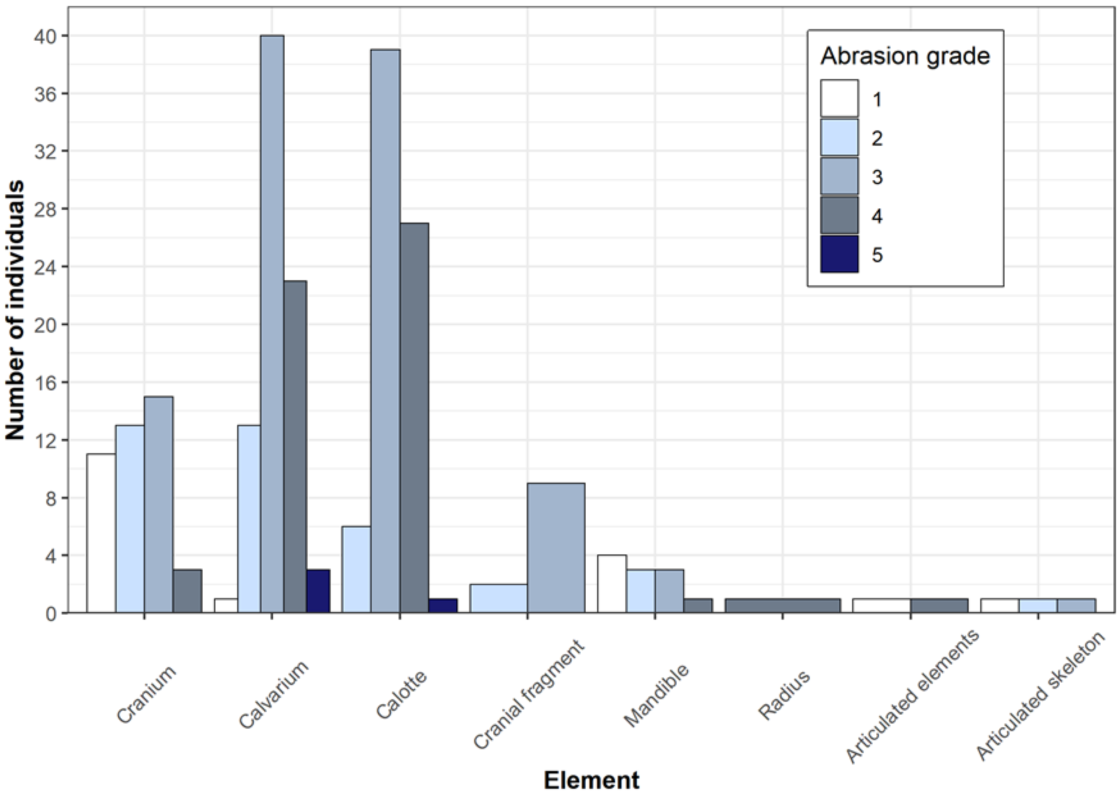

Figure 6.8: The distribution of McKinley (2004) abrasion grades for each element type. The single skeletal elements are presented according to individual bone types (e.g., cranium, femur, mandible).

6.3.1.2.3 Sediment impaction

Some degree of sediment impaction was present in 25.6% (57/223) of the assemblage, absent in 72.2% (161/223), and unobservable in 2.2% (5/223). An example of sediment impaction among the Thames assemblage is given in Figure 6.9.

Figure 6.9: An example of sediment impaction encountered in the River Thames assemblage (SK 1490). The white arrow indicates a number of small stones which are wedged in the left external auditory meatus. © The Trustees of the Natural History Museum, London.

6.3.1.3 General taphonomic changes

6.3.1.3.1 Staining

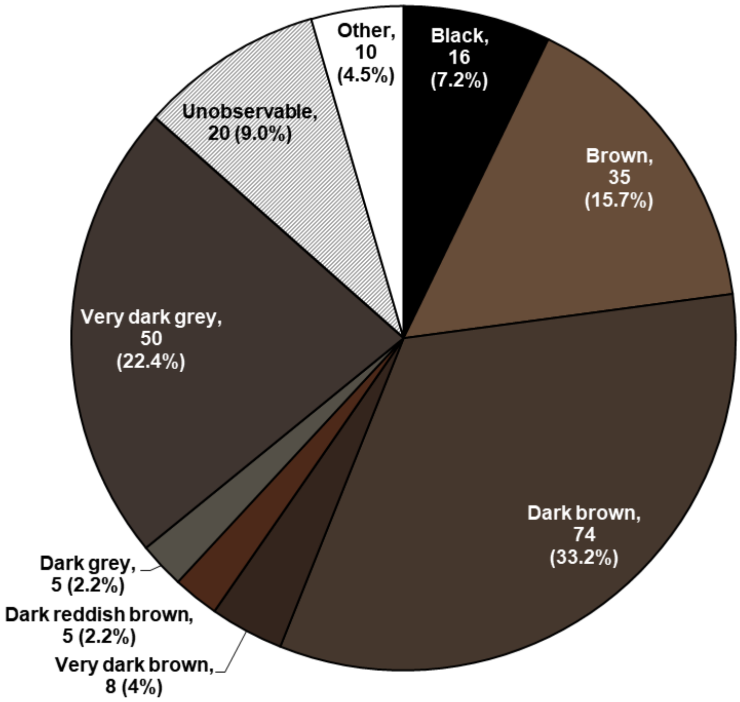

Figure 6.10: Pie chart of the generalised staining colours recorded in the River Thames assemblage. The colours used in the figure are representative of the colour groups as presented in the Munsell© soil colour chart. N.B. the "Other" category is comprised of colours represented by three or fewer elements: pale brown (n=1), light brown (n=1), dark greyish brown (n=1), very dark greyish brown (n=3), light yellowish brown (n=1), yellowish brown (n=2), dark yellowish brown (n=1).

The general staining colours recorded for the overall River Thames assemblage are presented in Figure 6.10, and are presented by period in Figure 6.11 and by location in Figure 6.12. Where colour was observable, all bone elements in the Thames assemblage presented forms of generalised brown, grey, or black staining. Dark brown (33.2%; 74/223), very dark grey (22.4%; 50/223), and brown (15.7%; 35/223) were the most commonly recorded colours.

Lighter colours were recorded for only a few elements: SK 19, a Neolithic calvarium from Crossness, was pale brown in colour; FSW01, an undated cranial fragment from Chambers Wharf, was light brown; SK 1523, a Post-Medieval cranium from Somerset House, was light yellowish brown; and SK 4140, an undated calotte from Richmond, and SK 1551, a Medieval skull from Whitehall Steps, were yellowish brown. Zone F, Central London, contained three of these individuals with lighter colouration (Figure 6.12).

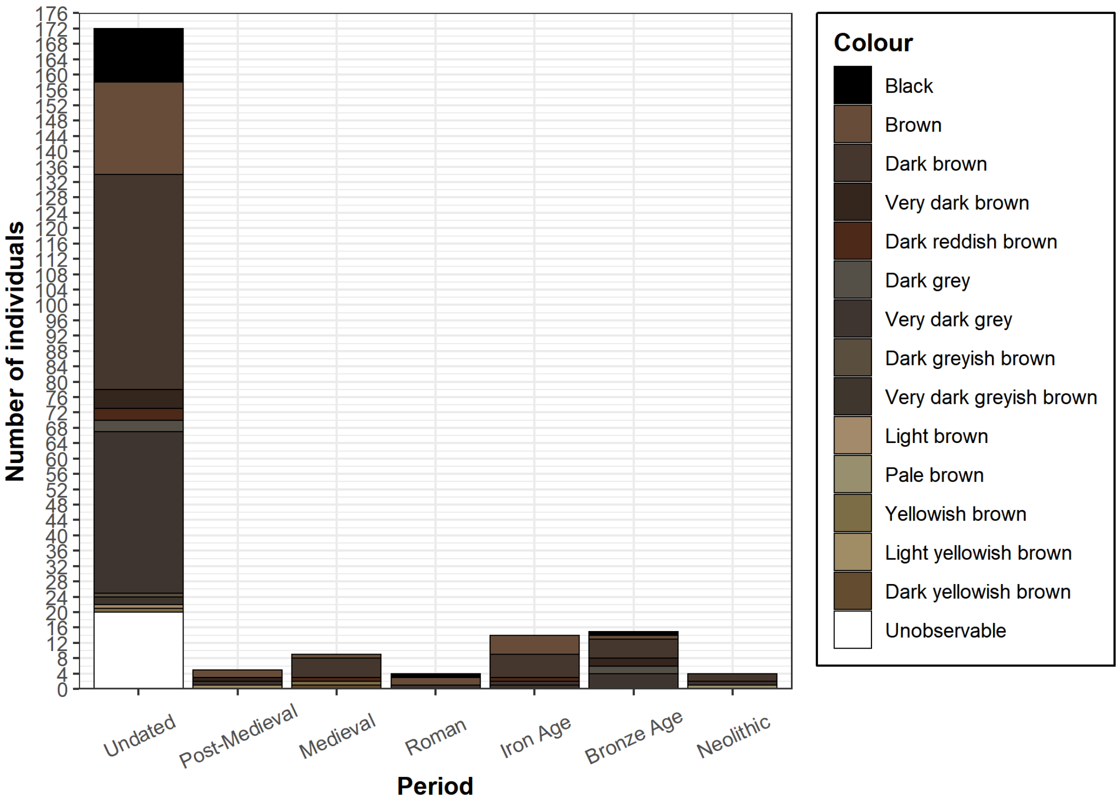

Figure 6.11: The generalised staining colours recorded in the River Thames assemblage, presented by time period. The colours used in the figure are representative of the colour groups as presented in the Munsell© soil colour chart.

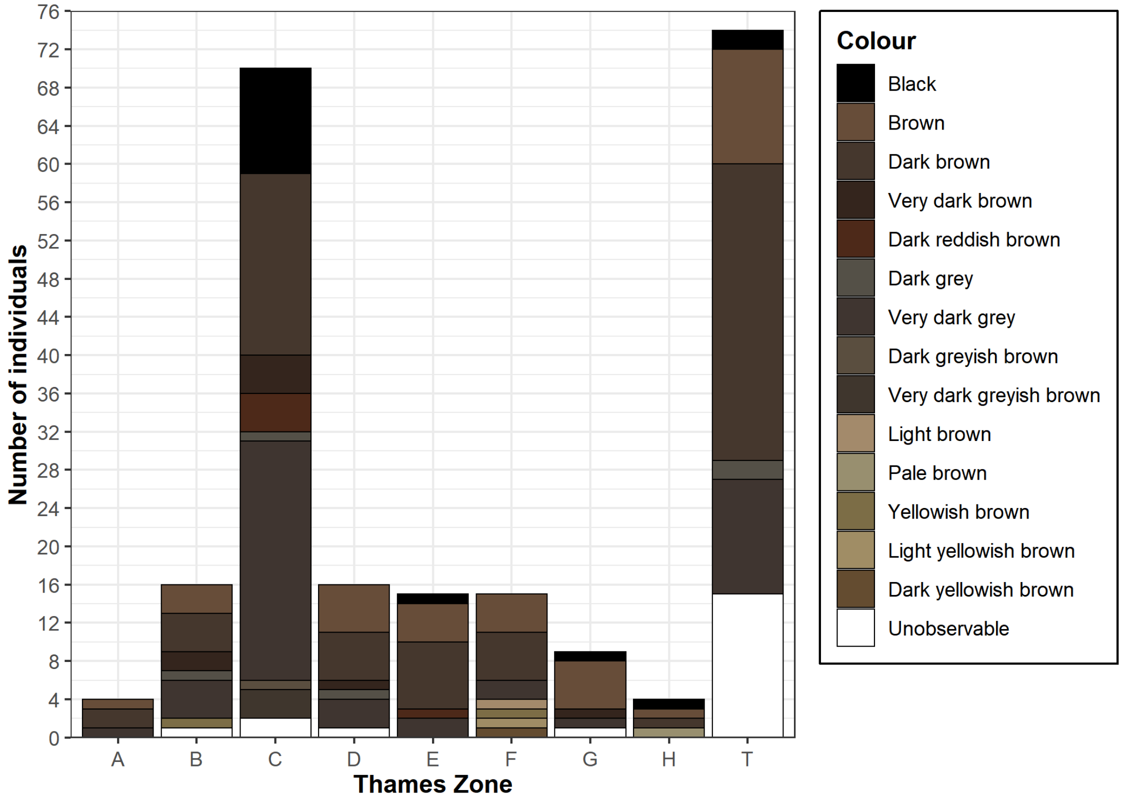

Figure 6.12: The generalised staining colours recorded in the River Thames assemblage, presented by Thames zone. See Section 4.1.1.2.4, and Figure 5.2 for description of Thames zones. The zones are labelled A to H, from the west to the east. Zone A= West outliers, zone B= Richmond to Kew, zone C= Mortlake to Hammersmith, zone D= Putney to Wandsworth, zone E= Battersea/Chelsea, zone F= Central London, zone G= Isle of Dogs, zone H= East outliers, T= Thames. The colours used in the figure are representative of the colour groups as presented in the Munsell© soil colour chart.

In addition to these generalised staining changes, patches of localised orange staining with a “rusty” appearance were noted on a high proportion of elements (50.7%; 113/223). Localised black staining was also noted in a moderate number of Thames remains (26.5%; 59/223)**.** The distribution of these localised forms of staining is presented by period in Table 6.11 and by location in Table 6.12.

Period	Orange staining	Black staining
Neolithic	50.0% (2/4)	50.0% (2/4)
Bronze Age	60.0% (9/15)	33.3% (5/15)
Iron Age	50.0% (7/14)	21.4% (3/14)
Roman	25.0% (1/4)	25.0% (1/4)
Medieval	22.2% (2/9)	44.4% (4/9)
Post-Medieval	40.0% (2/5)	40.0% (2/5)
Undated	52.3% (90/172)	24.4% (42/172)
Total *n*	**50.7% (113/223)**	**26.5% (59/223)**

Table 6.11: The distribution of localised orange and black staining in the River Thames assemblage, according to time period. The numbers in brackets represent the number of elements affected out of the number of observed elements in that given subsample.

Zone	Orange staining	Black staining
A	25.0% (1/4)	75.0% (3/4)
B	56.3% (9/16)	37.5% (6/16)
C	57.1% (40/70)	21.4% (15/70)
D	56.3% (9/16)	25.0% (4/16)
E	33.3% (5/15)	33.3% (5/15)
F	26.7% (4/15)	33.3% (5/15)
G	44.4% (4/9)	33.3% (3/9)
H	50.0% (2/4)	25.0% (3/4)
T	52.7% (39/74)	20.3% (15/74)
Total *n*	**50.7% (113/223)**	**26.5% (59/223)**

Table 6.12: The distribution of localised orange and black staining in the River Thames assemblage, according to Thames zone. The numbers in brackets represent the number of elements affected out of the number of observed elements in that given subsample. See Section 4.1.1.2.4, and Figure 5.2 for description of Thames zones. The zones are labelled A to H, from the west to the east. Zone A= West outliers, zone B= Richmond to Kew, zone C= Mortlake to Hammersmith, zone D= Putney to Wandsworth, zone E= Battersea/Chelsea, zone F= Central London, zone G= Isle of Dogs, zone H= East outliers, T= Thames.

There do not appear to be any particularly strong patterns in the distribution of general or localised staining by time period or location. However, zone F (Central London), contained three of the five elements with lighter colouration (Figure 6.12) and none of the large subsample of undated, Bronze Age, or Iron Age individuals presented lighter colouration (Figure 6.11). It is also of note that there are no elements of "brown" colour in zone C (Mortlake to Hammersmith), although this is by far the largest zone subsample (70 individuals) and "brown" elements appear in every other zone (Figure 6.12). All individuals in zone C either had darker colouration, or the colour was not observable. The western zones B (Richmond to Kew), C (Mortlake to Hammersmith), D (Putney to Wandsworth), and also zone T (Thames) presented the highest prevalences of localised orange staining (Table 6.12), and this was also more prevalent among the prehistoric (Neolithic, Bronze Age, Iron Age) individuals than those dated to the later periods (Table 6.11).

6.3.1.3.2 Subaerial Weathering

The Thames assemblage presented some evidence for the subaerial weathering of elements, according to the Behrensmeyer (1978) scale (Figure 6.13). Evidence for weathering was present on 11.2% (25/223) of the elements. Seven of the weathered elements were from Mortlake, two of which were Bronze Age in date (GEN01 27 and SK 4070).

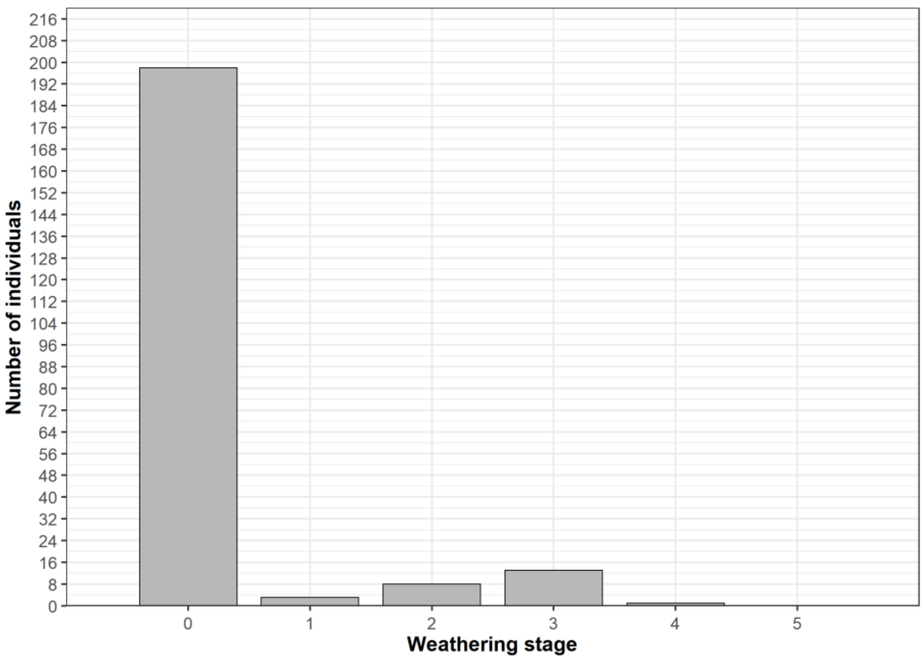

Figure 6.13: The distribution of Behrensmeyer (1978) weathering stages in the Thames assemblage.

6.3.1.3.3 Terrestrial animal modification

Five elements in the Thames assemblage presented unambiguous evidence of modification by terrestrial animal teeth. This resembled carnivore activity in four cases (BATT30 1, SK 1490, SK 1527, SK 4072), and rodent gnawing in one (SK 4178).

6.3.2 River Thames assemblage taphonomic histories discussion

6.3.2.1 Element representation

6.3.2.1.1 Articulated skeletons and articulated elements

A small number of articulated skeletons and articulating elements were present within the River Thames assemblage. As may be expected, these finds were all recovered during foreshore or construction activities, rather than dredging. The possible exception to this is SK 1526, an Iron Age mandible with articulated facial bones, reported to have been "found in the mud" at Northfleet. Where dated, these remains all belong to the Medieval and Post-Medieval periods, with the exception of SK 1526 and the Yabsely Street burial, a Neolithic skeleton recovered from the former foreshore surface.

6.3.2.1.2 Single skeletal elements

Isolated cranial remains were by far the most frequently-encountered elements in the Thames assemblage, comprising 92.0% (207/225) of single skeletal elements. This is consistent with the findings of previous studies of the Thames assemblage, and is an observation which has previously been used to support both theories of ritual deposition involving the selective deposition of crania (Bradley and Gordon, 1988; Schulting and Bradley, 2013), and the idea that the assemblage largely represents a fluvially accumulated assemblage, with the over-representation of crania arising through a combination of the erosion of riverside burials, and the bodies of drowning victims (Knüsel and Carr, 1995, 1996) (see Section 3.2.3.1).

As considered in Section 3.2.3.2, such extremes of argument are of limited use; the presence of fluvially-accumulated depositions does not preclude the remains from having arisen through a form of ritual deposition, and the deposition of isolated crania is not a necessary hallmark of ritual deposition. However, interpreting the element

representation of the River Thames assemblage is an integral part of examining the taphonomic histories of the remains.

It is possible that the over-representation of cranial remains among the single skeletal elements in the assemblage is, to a large extent, the result of recovery biases. It has long been noted in archaeological and forensic literature that, when encountered, cranial bones are particularly recognisable as being “human”, whereas other human bones are often not identified (e.g., Nawrocki et al., 1997).

This is particularly relevant to the dredged remains, which comprise the majority of the assemblage, as they were recovered by dredger crews, who were not likely to have had specialist knowledge relating to human anatomy. Furthermore, it is likely that cranial remains would have been the only bones of interest: the fact that dredgermen were permitted to sell their finds to antiquarian collectors means they would have been likely to overlook or discard finds which they deemed less profitable (Ehrenberg, 1980; Cotton, 1999:63; York, 2002:79). Even cranial remains were apparently not always valued when identified, as illustrated in a diary entry of the time by a Dr Joseph Stevens: “In April 1882 (at Taplow) the dredgers brought up two axes…three human skulls were found at the same point. Of these, one was retained, and the other two thrown back into the water.” (Stevens, 1883:345 in Lamdin-Whymark, 2008:27).

Indeed, many of the non-cranial single skeletal elements in the River Thames assemblage are recent foreshore finds, recovered by individuals with an archaeological background. All five of the post-cranial elements were recovered from the foreshore during recent archaeological surveys (see Figure 6.14 for a photo of an adult humerus recovered from the Putney foreshore in 2019). Of the thirteen isolated mandibular remains, four were recent foreshore finds.

Figure 6.14: An adult humerus (Putney 3) recovered from the Putney foreshore in 2019, during a Thames Discovery Programme monitoring visit. Photo is author's own.

This observation regarding the potential influence of recovery biases on the River Thames assemblage element representation limits the extent to which any inferences regarding deposition can be drawn from the over-representation of single cranial remains in the assemblage. In fact, it hints that mandibular and post-cranial elements may be much more prevalent in the "true assemblage" (i.e., the assemblage prior to recovery), and perhaps weakens ideas relating to the selective deposition of crania into the riverine deposits for the prehistoric material, and places more emphasis on the idea of the entry of whole/partial bodies, whether fleshed or skeletonised. This would be consistent with the assemblage composition revealed in palaeochannels of the Thames slightly further upstream at Eton Rowing Course, where multiple Neolithic, Bronze Age and Iron Age post-cranial elements were recovered along with cranial remains in controlled excavations (Allen et al., 2000, see Section 2.2.1).

SK 1526, a mandible with articulating cranial elements, provides the only direct evidence for the entry of prehistoric fleshed cranial remains in to the main river deposits. However, this is also strongly implicated in the case of FFW 03, an undated subadult calotte recovered from the Putney foreshore. This calotte had completely open sutures between the frontal and both parietals, with each bone present as a separate fragment, indicating that decomposition of flesh took place in-situ.

6.3.2.2 Fluvial transport

As aforementioned, it has previously been argued that the River Thames assemblage is likely to largely represent a fluvially-accumulated assemblage, on the basis of both the over-representation of cranial remains, and also the loss of facial bones (Knüsel and Carr, 1995) (see Section 3.2.3.1).

As has been demonstrated in the previous section, it is difficult to draw interpretative conclusions from the apparent dominance of cranial remains in the assemblage owing to recovery biases. This means interpretations of fluvial origins must be based on the taphonomic changes observed on the bones themselves.

The River Thames assemblage does present substantial evidence for many of the taphonomic changes associated with fluvial transport. The vast majority of the cranial elements had lost the facial bones (79.7%; 165/207). This change can arise as the delicate facial bones are the least robust, and can be damaged as crania roll and tumble along the riverbed (Nawrocki et al., 1997). A moderate degree of generalised surface abrasion was present and, where this could be observed, almost all elements presented a degree of surface polishing. Surface polishing was also noted in remains recovered from the deposits of the nearby Walbrook stream, which are interpreted as having been fluvially disturbed (Harward et al., 2015), and can arise through exposure to moving water containing fine silty deposits (Brooks and Brooks, 1997). Approximately a quarter of the Thames assemblage presented evidence for sediment impaction. Sediment impaction is considered highly indicative of a fluvial origin, as there are few processes operating in standing bodies of water which could produce such a process (Evans, 2014:125).

It is important to consider that none of these changes in themselves are diagnostic of the remains having been physically transported by the action of the water, and could have arisen through exposure to flowing water with the bones themselves remaining relatively in-situ (Haglund and Sorg, 2002). However, the combination of changes in the assemblage, and in particular the loss of facial bones, does suggest that many of the Thames remains are likely to have been fluvially transported at some point in their depositional histories, at least to some extent.

As discussed previously (Section 3.2.3.2), evidence for exposure to fluvial transport is of limited interpretative application in terms of deposition in as much as it doesn't

preclude the remains from having entered the river under any particular circumstances. However, the evidence for exposure to active fluvial environments identified here does provide evidence for many of the Thames remains having been in active Thames channels at some point in their depositional history, as opposed to being relatively in-situ deposits in former dryland surfaces. It also raises the possibility that many of the remains may have been transported some distance from their original location of entry into the river, which could have implications for the extent to which spatial patterns in the data could be considered meaningful. In large river systems, bodies have been observed to travel as much as hundreds of miles in days or months (Evans, 2014:119).

6.3.2.3 General taphonomic changes

Almost all of the elements in the River Thames assemblage presented a form of brown, grey or black staining. Although such changes can occur in remains buried in terrestrial contexts, this form of staining is highly consistent with the colour changes observed in bones recovered from other fluvial systems, and is likely to occur through burial in the riverbed, or through submersion in discoloured water (Dunbar et al., 1987; Nawrocki et al., 1997; Evans, 2014; Pokines, 2018). Lighter colours were only observed on five elements, three of which were recovered from zone F (Central London) and none of which belonged to the larger subsample of undated, Bronze Age, or Iron Age individuals. These lighter colours could reflect different depositional histories for these elements (e.g., no prolonged period of submersion).

Localised orange staining with a “rusty” appearance was recorded on a high proportion of elements (50.7%; 113/223). Similar changes have been observed in remains recovered from the nearby Walbrook stream deposits, and likely reflect the precipitation of iron oxides in a damp and aerobic environment (Harward et al., 2015). The prevalence of orange staining was highest in the western Thames zones and in the individuals dated to the prehistoric period, which could potentially reflect aspects of the depositional environment at these locations or deposition in these periods, though the pattern is not particularly strong. Localised black staining was also noted in a moderate number of Thames remains (26.5%; 59/223). Again, this was also observed on the Walbrook human remains, and was taken to be indicative of proximity to vivianite, an iron oxide formed in anaerobic conditions (Harward et al., 2015). Black staining in bones recovered from rivers has also been observed to occur in relation to adipocere formation (Evans, 2014). Further work (e.g., ramen spectroscopy (Cartajena et al., 2021)) would be needed to identify the exact causative agents for this staining.

However, these changes do confirm deposition in wet environments for the majority of the Thames assemblage, for at least a portion of their depositional histories.

Some taphonomic changes associated with a period of surface exposure were identified in this study: 11.2% (25/223) of elements presented weathering changes, and five elements presented evidence of modification by terrestrial animals. Two elements presented both changes (SK 4178 and SK 1490). This finding is somewhat contrary to the results of previous examinations of the River Thames assemblage where specific attempts to identify such changes had been made. In their study of 182 Thames crania, Knüsel and Carr (1995) identified no changes associated with surface exposure, though only specifically reported changes associated with animal activity. Edwards et al., (2009) reported weathering changes in one of the 18 Thames crania examined.

Where dated, the elements presenting these changes belonged to various periods: the Bronze Age (n=3), the Medieval period (n=2) and the Post-Medieval period (n=2). Of the affected Bronze Age individuals, two dated to the Early Bronze Age (GEN01 52 from Syon Reach and GEN01 27 from Mortlake), and the other to the Late Bronze Age (SK 4070 from Mortlake). Interestingly, nine of the 50 individuals from Mortlake (18.0%) presented some evidence for surface exposure, which could potentially have implications for assemblage formation processes in this area. SK 4072 from Mortlake is particularly notable for the extent of carnivore modification they present, with pits, punctures, scoring and furrows all identified.

In each case such surface exposure could have occurred before or after entry in to the river deposits. It is also possible that the elements were subject to multiple periods of exposure and submersion, as river dynamics changed. GEN01 49, a calotte with a general Thames location, presented a patterning of changes which indicate it lay for some time partially embedded in the riverbed and partially exposed to the elements: the superior half of the calotte was extensively weathered, whereas the inferior half was well-preserved and presented no weathering. The two areas were separated by a darker band of circumferential staining, which indicates the resting position of the calotte within the underlying substrate (Nawrocki et al., 1997). In this case, the weathering appears to have taken place after an initial period of complete burial or submersion. This is indicated by the fact that the remaining patches of cortical bone on the weathered surface were stained dark brown, but the weathered bone surfaces were light in colour, reflecting a period of sun-bleaching (Dupras and Schultz, 2013).

Although only a relatively small proportion of the Thames assemblage presented taphonomic changes associated with a period of surface exposure, the actual extent of surface exposure experienced by elements in the assemblage could have been much higher. Cranial elements, which comprise the majority of the assemblage, are less susceptible to weathering changes than many other skeletal elements (Madgwick and Mulville, 2012). Additionally, in an experimental study in a British environment, sub-aerially exposed bones have been observed to remain in weathering stage 0 for up to eight years (Andrews and Cook, 1985). Crania have also been observed to be frequently left untouched by carnivores owing to their morphology (Pokines, 2014). Furthermore, the extent of generalised abrasion on many of the Thames remains could have obscured the presence of changes associated with weathering or animal modification.

6.3.3 River Thames assemblage taphonomic histories summary

Despite the presence of a small number of articulated skeletons and elements, which are largely Medieval and Post-Medieval in date, the vast majority of the Thames assemblage is comprised of single skeletal elements; and cranial elements in particular. Owing to the effects of recovery biases, the apparent over-representation of cranial elements in the assemblage is considered here to be of limited interpretative value, despite previously having much significance placed upon it (Bradley and Gordon, 1988; Knüsel and Carr, 1995).

The taphonomic modifications observed on the bones themselves indicated exposure to wet, fluvial environments for a large proportion of the assemblage, and raise the possibility that many of the single skeletal elements could have been fluvially transported at some point in their depositional history. This in turn, could have implications for analyses of spatial patterning in the data, though the extent to which abrasion correlates with transport distance is unknown (Nawrocki et al., 1997; Evans, 2014). A small portion of the assemblage, including elements of Bronze Age date, presented evidence for surface exposure at some point in their depositional history, whether prior or subsequent to their initial entry into the river deposits.

6.4 Maynard Reservoir assemblage taphonomic histories

6.4.1 Maynard Reservoir assemblage taphonomic histories results

6.4.1.1 Element representation and MNI

The elements present within the Maynard Reservoir assemblage are presented in Table 6.13, alongside their distribution according to broad age group (i.e., adult, subadult, undetermined). In total, 33 separate elements were identified. Five of these were articulating elements: three skulls, a left and right humerus pair belonging to an adolescent, and a subadult cervical vertebrae pairing. Cranial and post-cranial elements belonging to both adults and subadults were present.

For adult remains, the minimum number of individuals (MNI) is eight, and is based on the number of mandibles. For subadults, the MNI is four, based on the frontal bone.

Element type	**Element**	**Number of elements**	**Broad age group**		
			Adult	**Subadult**	**Undetermined**
Articulating elements	Skull	**3**	1	2	0
	Left + right humerii pair	**1**	0	1	0
	Cervical vertebrae pair (atlas + C3)	**1**	0	1	0
Single skeletal elements (cranial)	Cranium	**2**	2	0	0
	Calvarium	**1**	0	1	0
	Calotte	**1**	1	0	0
	Frontal	**2**	1	1	0
	Left parietal	**1**	0	0	1
	Mandible	**8**	7	1	0
Single skeletal elements (non-cranial)	Cervical vertebrae (atlas)	**1**	1	0	0
	Left scapula	**1**	0	1	0
	Left humerus	**2**	2	0	0
	Right humerus	**1**	1	0	0
	Left radius	**2**	2	0	0
	Ribs	**3**	2	1	0
	Left inominate	**1**	1	0	0
	Left femur	**1**	1	0	0
	Left fibula	**1**	1	0	0
Total *n* elements		**33**	**23**	**9**	**1**

Table 6.13: The elements comprising the Maynard Reservoir assemblage. The elements are shown according to their broad age group (i.e., adult, subadult, undetermined), as this was important to the determination of MNI.

6.4.1.2 Fluvially-derived taphonomic changes

6.4.1.2.1 Loss of facial bones

Of the 10 cranial elements, half presented facial bones (three skulls and two crania) and facial bones were absent for half (one calvarium, one calotte, two frontal bones, and one parietal).

6.4.1.2.2 Abrasion

The elements of the Maynard Reservoir assemblage presented relatively little abrasion according to the McKinley (2004) scoring system (Figure 6.15). Abrasion grade 1 (slight and patchy surface abrasion) was the most frequently recorded, and was present on 48.5% (16/33) of elements. Grade 2 was the next most frequently-recorded abrasion grade, present on 27.3% (9/33) of elements.

Polishing was recorded on all 33 elements.

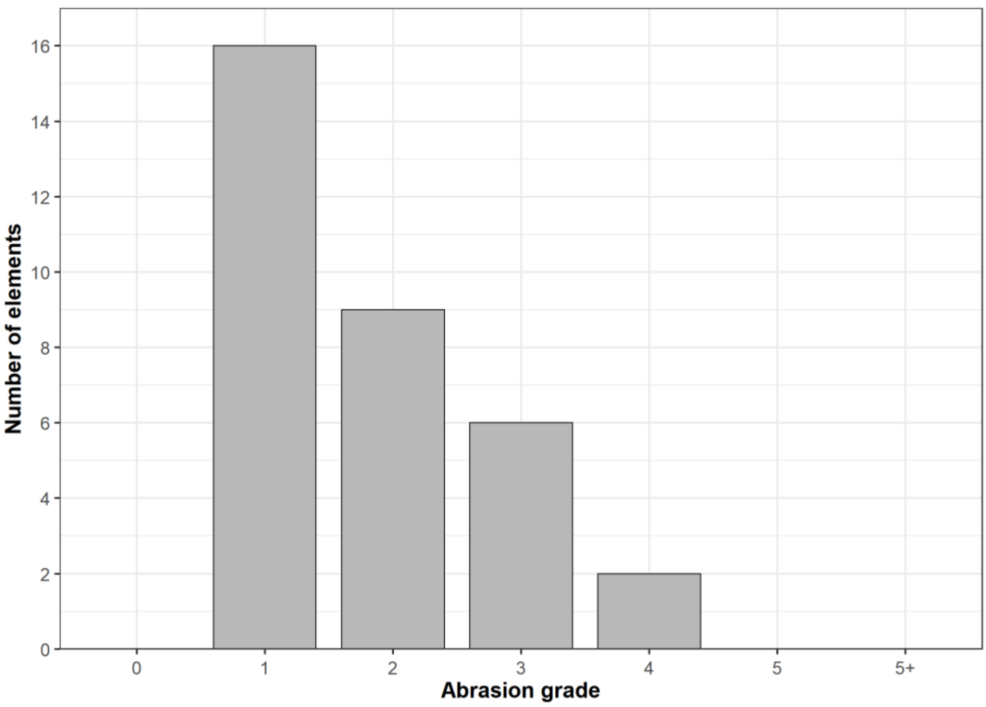

Figure 6.15: The distribution of McKinley (2004) abrasion grades in the Maynard Reservoir assemblage.

6.4.1.2.3 Sediment impaction

Only one instance of sediment impaction was observed in the Maynard Reservoir assemblage, giving it a low prevalence of 3.0% (1/33). Sediment impaction was absent in 60.6% (20/33) of elements and unobservable in 36.4% (12/33).

6.4.1.3 General taphonomic changes

6.4.1.3.1 Staining

The general staining colours recorded for the Maynard Reservoir assemblage are presented in Figure 6.16. Where colour was observable, all bone elements in the Maynard Reservoir assemblage presented forms of generalised brown staining. Brown was the most commonly recorded colour (57.6%; 19/33), followed by dark brown (33.3%; 11/33), and very dark greyish brown (6.1%; 2/33).

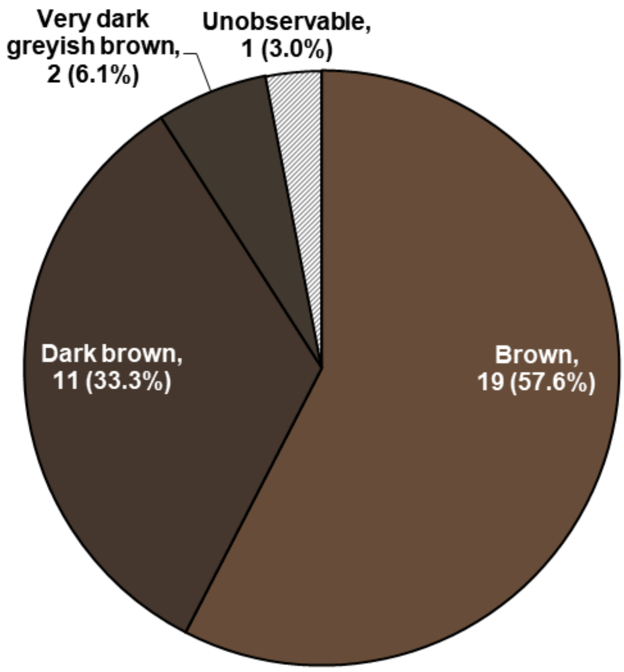

Figure 6.16: Pie chart of the generalised staining colours recorded in the Maynard Reservoir assemblage. The colours used in the figure are representative of the colour groups as presented in the Munsell© soil colour chart.

6.4.1.3.2 Subaerial weathering

The Maynard Reservoir assemblage presented little evidence for the subaerial weathering of elements, according to the Behrensmeyer (1978) scale Figure 6.17. The early stages of weathering were present on five elements (15.2%; 5/33).

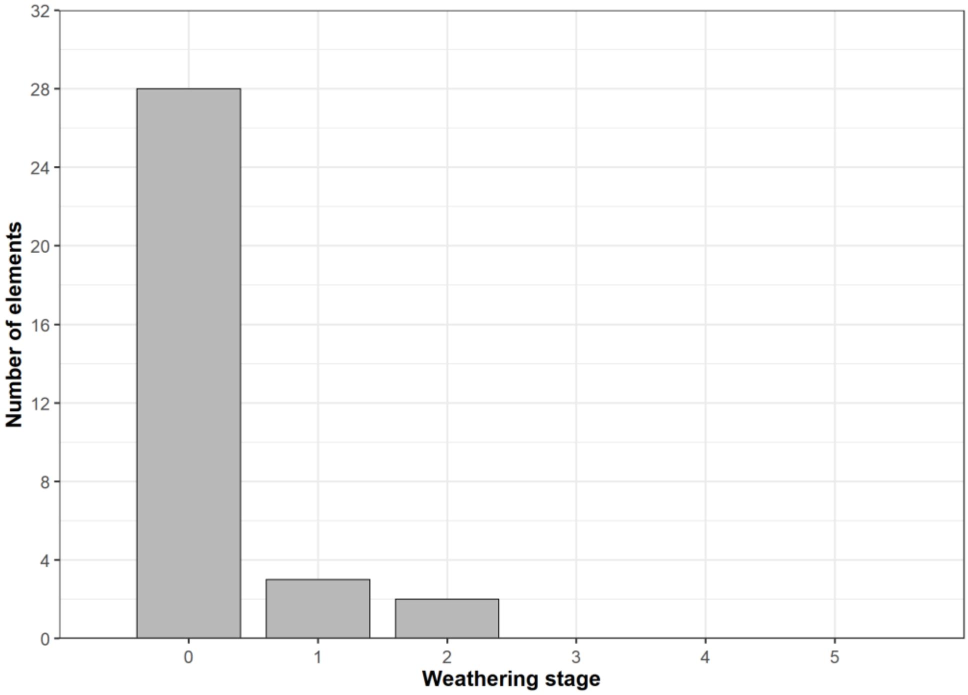

Figure 6.17: The distribution of Behrensmeyer (1978) weathering stages in the Maynard Reservoir assemblage.

6.4.1.3.3 Terrestrial animal modification

Eight of the 33 elements (24.2%) presented evidence of modification via terrestrial animal teeth. In four instances this resembled rodent gnawing (see Figure 6.18 for an example provided by SK 4194) and in four resembled carnivore gnawing.

Figure 6.18: Rodent gnawing marks on SK 4194, a calotte in the Maynard Reservoir assemblage. The anterior view of the calotte is given in the left image, and a zoom in of the area of rodent gnawing (the white box) is given in the right image. Rodent gnawing is indicated with a black arrow. N.B., the ectocranial surface of SK 4194 also presented multiple groups of short, often parallel striations, an example of which is indicated with a black arrow. Further investigation, including the application of analytical techniques beyond the macroscopic level (e.g., 3D microscopy, SEM), would be needed to identify the likely origin of these marks: e.g., scratches sustained during exposure to a fluvial environment (e.g., Nawrocki et al., 1997), damage sustained during excavation/cleaning (e.g., White and Toth, 1989), or human-induced perimortem modification such as cut marks or scrape marks (e.g., Wallduck and Bello, 2016; Bello and Galway-Witham, 2019). Similar marks were observed on other elements in the Maynard Reservoir assembledge, although to a much lesser extent. © The Trustees of the Natural History Museum, London.

6.4.2 Maynard Reservoir taphonomic histories discussion and summary

Thirty-three elements were present in the Maynard Reservoir assemblage, including post-cranial and cranial elements belonging to both adults and subadults. Mandibles provided an adult MNI of eight, and the frontal bone provided a subadult MNI of four. Five articulating elements were present suggesting that, at least for these elements, decomposition took place in-situ. As with the River Thames assemblage, it is possible that the element representation of the Maynard Reservoir has been affected by recovery biases because it was excavated before the development of modern excavation standards; however, multiple small elements are present, which are not easily recognisable as human (e.g., subadult carnival vertebrae and ribs). It is therefore possible that the recovery of the Maynard Reservoir assemblage was fairly complete.

The observed element representation, in combination with the lack of taphonomic changes associated with exposure to fluvial environments, suggests that the assemblage is not likely to represent a highly fluvially-accumulated assemblage. In

terms of element representation, this was indicated by the presence of a range of elements with different fluvial transport potentials (e.g., large bones and small bones, ribs and crania) and the presence of multiple articulating elements (e.g., skulls) (Nawrocki et al., 1997; Pokines, 2014). In terms of taphonomic modification of the bones themselves, there was a relatively good retention of facial bones, only one instance of sediment impaction, and a low level of generalised surface abrasion. Multiple, delicate subadult crania remained intact.

However, the presence of polishing on almost all of the elements does suggest exposure to moving water, albeit it slow-moving. The consistent brown staining observed in the remains also indicates exposure to water though, as aforementioned in relation to the River Thames assemblage, this can also arise through exposure to soil with a high organic content.

Twelve of the 33 elements (36.4%) presented evidence for subaerial exposure in the form of weathering and/or terrestrial animal modification by rodents or carnivores. As discussed in relation to the River Thames assemblage, the actual extent of subaerial exposure may have been greater. Carnivore modification, present on four elements, is an interesting idea to consider in relation to the element composition of the assemblage: the over-representation of cranial and mandibular elements could reflect the fact that these elements are often consumed last by carnivores, and are less easy to transport compared to other elements (Pokines, 2014). In relation to this carnivore damage, it is also interesting to observe that the bones of wolf were reported from the same deposits as some of the human remains (see Section 5.2.3).

In addition to the changes considered here many of the remains also presented evidence of root staining, which could also hint at a period of deposition in a more terrestrial, or a highly vegetated watery, environment.

6.4.2.1 Maynard Reservoir assemblage taphonomic histories summary

Shell marl deposits, within which several of the Maynard Reservoir human remains were specifically reported to have been found, were also identified at the site of Enfield Lock, around 10 km upstream of the Maynard Reservoir (see Section 5.2.3.2). There, they were linked to the presence of a slow-flowing river, surrounded by fen and marsh (Chambers et al., 1996). On the basis of this environmental context, combined with the taphonomic data outlined above, it is suggested that much of the Maynard Reservoir

assemblage could have been formed through the excarnation and decomposition of bodies or partial bodies in an open environment: possibly in the slow-moving palaeochannels of the River Lea, or in the adjacent marshy areas. Some of the human remains appear to have been fleshed when they entered the river channels. This applies particularly to the subadult skulls SK 4192 and SK 4198 which are both articulating elements and directly documented as having been recovered from the shell marl. Periods of overbank flooding, which have been identified in Late Bronze Age contexts further upstream at the site of Innova Park (see Section 5.2.3.2), could have affected the formation of the assemblage; for example, causing a degree of fluvial movement of the remains around the landscape (e.g., between marshy areas and river channels).

Chapter 7 Demography and violence-related trauma

This first part of this chapter addresses Aim C: to examine the demographic (i.e., age-at-death and sex) profile of the assemblages. The results and discussion are presented for the River Thames assemblage first (Sections 7.1 and 7.2, respectively), followed by the Maynard Reservoir assemblage (Sections 7.3 and 7.4, respectively). The second half of the chapter addresses Aim D: to examine the patterns and prevalence of violence-related trauma within the assemblages. Again, the River Thames assemblage is considered first, with the results presented in Section 7.6 and the discussion in Section 7.7. The Maynard Reservoir results are presented in Section 7.8 and the discussion in Section 7.9.

7.1 Demography: River Thames assemblage results

7.1.1 The overall dataset

The age-at-death and sex structure of the River Thames assemblage is presented in Figure 7.1

The majority of individuals, 85.7% (203/237), were assigned an adult age-at-death category. Subadults comprised 9.7% (23/237) of the assemblage. Age-at-death was undetermined for 4.6% of individuals (11/237). Excluding the remains for which age-at-death could not be determined, the proportion of subadults to adults within the River Thames assemblage was 10.2% (23/226) to 89.8% (203/226). Within both the adult and subadult age groups, the non-specific age categories were the best-represented: 40.0% (81/203) of the adult individuals were in the general adult (>18 years) category, while 56.5% (13/23) of subadult individuals were in the general subadult (<18 years) category. Of the adults assigned a specific age-at-death category, the majority belonged to the middle aged adult category, 26-45 years (55.0%, 67/122). Of the 10 subadults assigned a specific age-at-death category, five belonged to the 0-11 years category, and five were adolescents in the 12-17 years category.

Disregarding the subadult individuals, for which sex was not estimated, sex was undetermined for 27.6% (59/214) of individuals. As outlined in the methods section (4.4.3), individuals were assigned to the undetermined sex category if either: their osteological sex was intermediate, as was the case for 64.4% (38/59) of the undetermined individuals; there were insufficient osteological data to estimate sex

25.4% (15/59); or if they were part of the non-osteological dataset (see Section 5.1.1) and it was not possible to obtain associated sex data (6/59).

Of the individuals assigned a specific sex (i.e., male or female), males represented 71.6% (111/155) and females only 28.4% (44/155). This corresponds to a male to female ratio in the River Thames assemblage of approximately 5:2. These figures include the 32 individuals for whom sex was genetically estimated: nine of which were determined to be female (28.1%, 9/32) and 23 male (71.9%, 23/32) (see also Table 7.2 and Appendix Table B.1).

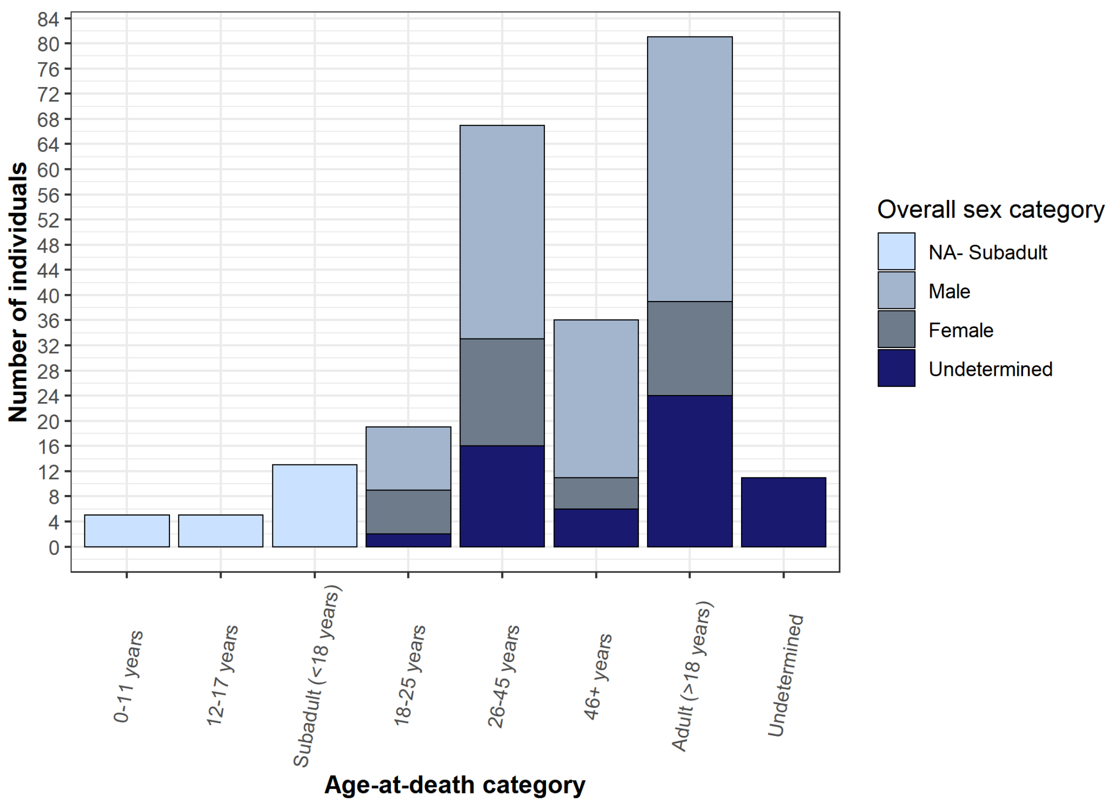

Figure 7.1: The age-at-death and sex structure of the River Thames assemblage. The age-at-death categories form the X axis, and the bars are coloured according to the overall sex categories (lightest blue = NA- subadult, light blue = male, grey-blue= female, dark blue = undetermined). See Section 4.4.3 for information on the derivation of the overall sex categories.

7.1.2 Temporal and spatial patterns

Figure 7.2 presents the age-at-death and sex structure of the River Thames assemblage according to time period.

All dated individuals were adults or of undetermined age, with the exception of four Iron Age subadults, and one Post-Medieval subadult. Three of the Iron Age subadults date to the Early Iron Age, and the other to the Middle Iron Age. Interestingly, two of these were recovered from the Putney foreshore in recent years: Putney 1, a mandible belonging to a subadult aged around six years old and radiocarbon dated 750-500 cal BC, and GEN01 4856, a subadult frontal bone dated 400-200 cal BC. A third subadult, FFW03, an undated calotte, was also recovered from the foreshore at Putney.

The male sex bias, where males represent the greater proportion of sexed individuals, was present in each time period Figure 7.2. For the Bronze Age, 71.4% (10/14) of sexed individuals were males and 28.6% (4/14) were females. These are genetic estimates for eight of the males, and all four of the females. Of the females, one is Early Bronze Age in date (GEN01 52 from Syon Reach), one Middle Bronze Age (SK 4167 from Battersea), and two Late Bronze Age (GEN01 29 from Mortlake, and SK 4062 from Kew). For the Iron Age, 70.0% (7/10) of sexed individuals were male, and 30.0% (3/10) were females. For five of the males, these are genetic sex estimations.

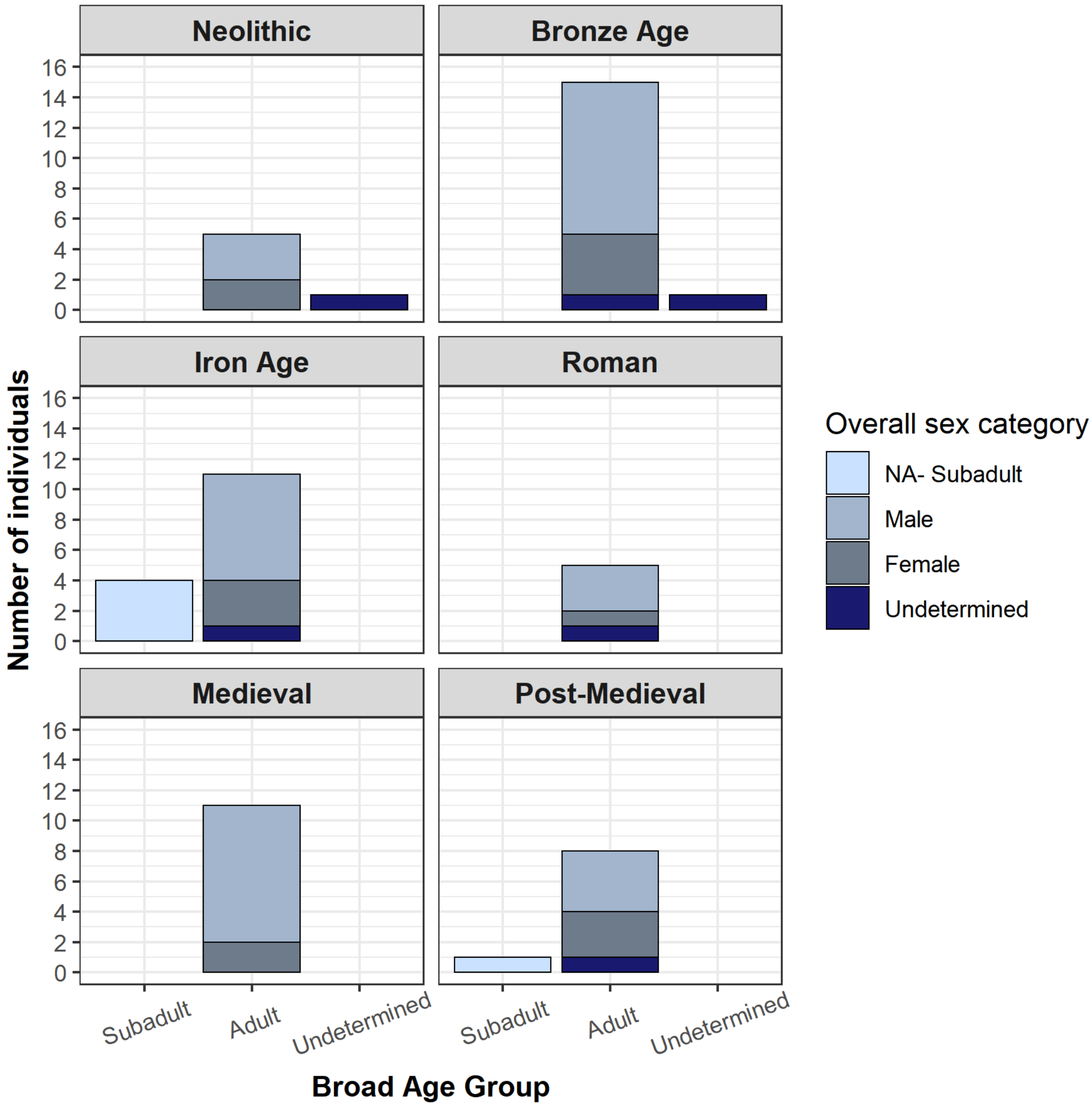

Figure 7.2: The age-at-death and sex structure of the River Thames assemblage, presented according to time period. The broad age-at-death categories (i.e., subadult, adult, undetermined) form the X axis, and the bars are coloured according to the sex categories (lightest blue = NA- subadult, light blue = male, grey-blue= female, dark blue = undetermined).

As aforementioned, the Mortlake group is the largest spatial subgroup of the River Thames assemblage, comprising 50 individuals. Radiocarbon dates exist for nine of the Mortlake individuals, and all fall between the Middle Bronze and Middle Iron Ages (see Section 6.1.3). Therefore, it is interesting to consider the demographic structure of the Mortlake group separately, and this is presented in Figure 7.3. Two subadults are present, with the remaining individuals being either adult (44 individuals) or of undetermined age (four individuals). Of the adult individuals assigned a specific sex, 25.0% were female (8/32) and 75.0% (24/32) were male. Radiocarbon dates exist for two of the females, one is Late Bronze Age (GEN01 29) and one is Middle Iron Age

(SK 4092). Four of the males have Bronze Age dates (SKs 4070, 4073, 4084, GEN01 27), and two Iron Age (SK 4069, SK 4074). These were genetic sex estimations for one female (GEN01 29), and four males (SK 4070, 4073, 4074, GEN01 27).

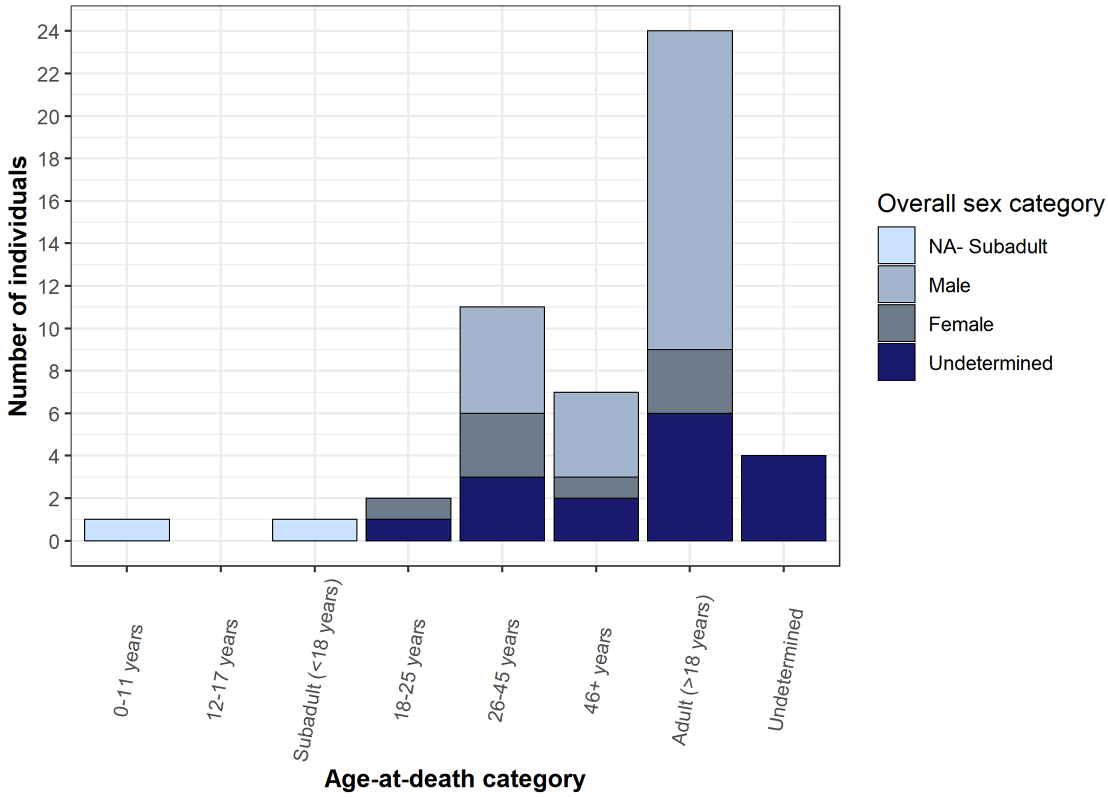

Figure 7.3: The age-at-death and sex structure of the Mortlake group. The age-at-death categories form the X axis, and the bars are coloured according to the sex categories (lightest blue = NA- subadult, light blue = male, grey-blue= female, dark blue = undetermined).

7.2 Demography: River Thames assemblage discussion

7.2.1 The overall pattern

The demographic profile of the River Thames assemblage is characterised by the under-representation of subadults (10.2% of aged individuals) compared to adults (89.8% of aged individuals), high numbers of middle aged adults (26-45 years) compared to older adults (46+ years), and younger adults (18-25 years), and a strong bias towards male individuals (71.9% of sexed individuals). Though the sample sizes are small, the under-representation of subadults and male bias are patterns which appear to be replicated across all time periods (Figure 7.2), and are present in the larger, potentially Bronze-Iron Age dominated Mortlake group (Figure 7.3).

The demographic profile of the River Thames assemblage is largely consistent with those which have been reported previously for different subsets (Bradley and Gordon, 1988; Knüsel and Carr, 1995, see Table 7.1), though in the current study the proportion of subadult to adult remains is higher, and the male bias is more pronounced.

The demographic profile does not resemble an attritional mortality profile, which would demonstrate high subadult mortality, steadily increasing numbers of adults with increasing age, and approximately equal proportions of males and females (Chamberlain, 2006). For instance, though a debated figure, it is generally considered that subadults should constitute around 30% of archaeological assemblages under conditions of attritional mortality (Lewis, 2006:22).

Such observations could hint at the processes involved in the formation of the assemblage, and potentially whether certain demographics were more or less likely to be incorporated into the assemblage. The remainder of this discussion will develop these ideas further, firstly in relation to the male bias and then the subadults.

Dataset	Subadults	Adults		Males	Females	Source
THAMES, THIS THESIS						
River Thames, all	**10% (23)**	**90% (203)**		**72% (111)**	**28% (44)**	This thesis
River Thames, Bronze Age	**0%**	**100% (14)**		**71% (10)**	**29% (4)**	This thesis
River Thames, Iron Age	**27% (4)**	**73% (11)**		**70% (7)**	**30% (3)**	This thesis
River Thames, Mortlake	**4% (2)**	**96% (44)**		**75% (24)**	**25% (8)**	This thesis
Maynard Reservoir, Walthamstow	**33%** (4)	**66%** (8)		**57%** (4)	**43%** (3)	This thesis
THAMES, PREVIOUS						
River Thames (Bradley and Gordon, 1988)	**3% (8)**	**97% (247)**		**60% (140)**	**40% (92)**	Bradley & Gordon 1988
River Thames (Knüsel and Carr, 1995)	**2% (4)**	**98% (178)**		**67% (103)**	**33% (51)**	Knüsel & Carr 1995
DRY LAND ASSEMBLAGES						
Late Iron Age attritional cemeteries, Dorset	**55% (48)**	**45% (40)**		**58% (23)**	**42% (17)**	Redfern 2011
Iron Age pit + inhumation burials, settlement sites, Upper Thames Valley	**19%**	**81%**		**38%**	**62%**	Lambrick, 2009
Late Bronze Age unburnt bone from British settlement sites	**28%**	**72%**		**54% (14)**	**46% (12)**	Brück 1995
Eton Rowing Course, land burials	**25% (3)**	**75% (9)**		**60% (3)**	**40% (2)**	Allen et al., 2000
WETLAND ASSEMBLAGES						
River Meuse, Netherlands	**10% (65)**	**90% (588)**		**75% (103)**	**25% (35)**	ter Schegget 2014
Weltzin 20, River Tollense, Germany	**24% (9)**	**76% (28)**		**81% (24)**	**19% (6)**	Brinker et al., 2013
Eton Rowing Course, palaeochannel remains	**0%**	**100% (14)**		**75% (6)**	**25% (2)**	Allen et al., 2000
British Bronze Age bog bodies/skeletons	**33% (7)**	**66% (15)**		**36% (4)**	**64% (7)**	Stevens & Chapman 2020
La Tene, Switzerland	**25% (4)**	**75% (12)**		**66% (8)**	**33% (4)**	Alt & Jud 2007

Table 7.1: The demographic profiles of the River Thames and Maynard Reservoir assemblages presented with comparative data. The percentages of subadult to adult individuals, and male to female individuals recorded in this thesis are shown alongside comparative data from previous studies of the Thames assemblage, and comparative dryland and wetland assemblages. The number of individuals used to calculate the percentages are presented in brackets.

7.2.2 The over-representation of males

7.2.2.1 Post-depositional factors

There are several post-depositional factors which may have contributed to the strong male bias present among the Thames assemblage, where males represent 71.6% (111/155) of individuals assigned a specific sex, and females 28.4% (44/155). Firstly, with regard to taphonomy, it is possible that male crania may have had an increased likelihood of surviving in a more intact state in a fluvial environment, as they are often more robust. Dredger crews, preferentially selecting cranial remains, would then have been more likely to be recovering male remains than female. However, in general, sex differences in skeletal preservation are not well documented (e.g., Walker et al., 1988), and many of the remains are of indeterminate or undetermined sex, so it is unlikely that such factors would have contributed much to the observed bias.

A more relevant contributory factor to the male bias may be the methodological issues associated with osteological sex estimation.

The sex of 98.5% (199/202) of the adult River Thames individuals (excluding the non-osteological group, see Section 4.4.3) was determined on the basis of skull morphology alone. The skull has been consistently demonstrated to be less reliable than the pelvis in terms of sex estimation, achieving accuracy rates of between 70.6%-96.9% in tests on known-sex skeletal collections (Meindl et al., 1985; Đurić et al., 2005; Lewis and Garvin, 2016; Thomas et al., 2016; Inskip et al., 2018). This lower accuracy is probably due to the fact that sexual dimorphism in the skull is driven strongly by differences in body size and musculature, and is therefore likely to vary considerably between populations according to factors such as activity patterns, disease, and dietary habits (Inskip et al., 2018).

Of particular relevance to the River Thames assemblage, an artificial male bias could be produced for a past population sexed using the skull, if they were more robust in general than the more modern populations upon which the methods were developed. Female individuals would be more likely to be misclassified as either male, or of indeterminate sex. Such a process was identified by Inskip et al., (2018) in the Medieval population from St John's Divinity School, Cambridge (13th-16th century AD), who proposed that greater female robusticity may have been driven by hard physical work and a coarser diet. It is reasonable to speculate that a similar process could have

contributed to the male bias of the River Thames assemblage. For instance, a recent study found that the interlimb strength proportions of Neolithic, Bronze Age, and Iron Age women from central European populations indicated that women in these prehistoric agricultural populations experienced rigorous physical labour (e.g., grain grinding) at levels far exceeding those experienced by modern women (Macintosh et al., 2017). For a single skeletal population, such an issue could be overcome to an extent by seriation of the expression of traits (e.g., Buikstra and Ubelaker, 1994:16) but this is not possible for the individuals in the River Thames assemblage as they are drawn from temporally diverse populations.

7.2.2.1.1 Utilising the genetic sex estimates

The genetic sex estimates which have been provided for 32 of individuals present a novel opportunity to test the accuracy of sex estimation methods when applied to the River Thames assemblage, and to explore the nature of the male bias. The genetic and osteological sex estimates are summarised together in Table 7.2. The osteological assessments were conducted by the author before the results of the genetic analysis were available.

Sex estimates		***n***	**%**
Osteological sex	**Genetic sex**		
Male	Male	20	91%
	Female	2	9%
Female	Female	4	80%
	Male	1	20%
Intermediate	Male	2	40%
	Female	3	60%
Total genetic female		**9**	
Total genetic male		**23**	
Overall total		**32**	

Table 7.2: Comparison of osteological and genetic sex estimations. The number of individuals given each combination of osteological and genetic sex estimations is shown (*n*), alongside the percentage of the overall genetic subsample that that particular combination represents (%).

A similar level of male bias was present in the genetic sample as in the overall sample: 71.9% (23/32) were male, and 28.1% were female (9/32). The genetic sample was not randomly derived however; it is comprised of individuals included in both the current and previous programmes of radiocarbon dating. This includes several individuals selected on the basis that they presented evidence of skeletal trauma, both by Schulting and Bradley (2013), and to some extent in this thesis (see Section 4.2.1.1). This selection effect could have contributed in part towards the male bias in the genetic subsample.

The overall accuracy of osteological sex estimation is 88.9% (24/27), when only individuals for whom it was possible to assign a sex were included (i.e., excluding individuals of intermediate osteological sex), and 75.0% (24/32) when individuals assigned an intermediate osteological sex were included. The accuracy is only slightly higher for males than for females: 91.0% (20/22) of individuals assigned a male osteological sex were genetically identified as males, whereas 80.0% (4/5) of osteological females were genetically identified as female. These figures are consistent with accuracy data published for sex estimations using the skull across a range of different populations of 70.6%-96.9% (Meindl et al., 1985; Đurić et al., 2005; Lewis and Garvin, 2016; Thomas et al., 2016; Inskip et al., 2018), and suggest that when a definitive sex identification is made (i.e., male, probable male, female, probable female) these are highly reliable, and that females are only slightly more likely to be misidentified than males.

The individuals of intermediate osteological sex were only slightly more likely to be female than male: of the five osteologically intermediate individuals, two were genetic males and three were genetic females (Table 7.2). This suggests that the individuals of intermediate osteological sex in the wider River Thames assemblage (38 individuals), are not particularly more likely to be female than male.

These data indicate that the osteologically-identified male bias in the overall River Thames assemblage is not purely an artefact of methodological biases. The actual level of male bias may be moderately lower than that identified however (71.6% male to 28.4% female), owing to the slightly lower accuracy with which females were identified osteologically (80.0%) and the slight bias towards individuals of intermediate sex being genetic females, though these factors would only adjust the level of male bias downwards slightly. However, when extrapolating to the overall sample on the basis of patterns identified in the genetic sample it is important to consider that the

genetic sample is small (32 individuals, only five of which were osteological females, and five of osteologically indeterminate sex). The genetic sample also contains a higher proportion of complete individuals than the overall assemblage, meaning that the accuracy figures may be slightly high for the overall assemblage. However, this would be the case for both male and female accuracy, and would therefore not necessarily affect the overall sex ratio.

7.2.2.2 Comparison with other assemblages

The previous sections have established that the male bias observed in the River Thames assemblage is not likely to have arisen through post-depositional factors, such as methodological issues, and can therefore be considered to be a real feature of the assemblage. This section provides a brief comparison of the male to female ratio of the River Thames assemblage with those of a range of other sites. These data are presented together in Table 7.1. The patterns presented here are raised again in the discussion of the deposition of the Bronze and Iron Age individuals in Chapter 9 (Section 9.1.1 and Section 9.1.2, respectively).

Although the sample sizes involved are small, the dryland sites of Bronze and Iron Age date presented in Table 7.1 all have a more even balance of males to females than the River Thames assemblage. For example, the Iron Age pit and inhumation burials of the Upper Thames Valley actually present a female bias: females represented 63% of adults assigned a sex (Table 7.1).

The River Thames male bias fits with a broader pattern of male bias which is consistently present among other later prehistoric watery assemblages (see Table 7.1). For example, a male bias is also present in the prehistoric remains from the Middle Thames palaeochannels at Eton Rowing Course further upstream along the Thames, although the sample size is small (eight individuals; Table 7.1). Three of the watery sites at which a male bias is present have been strongly linked to conflict, including: La Téne on Lake Neuchâtel, Switzerland; Weltzin 20 on the River Tollense, Germany, and Kessel on the River Meuse, Germany; see Table 7.1 and Chapter 2 for descriptions of the sites.

7.2.3 Subadults

7.2.3.1 Subadult under-representation: are post-depositional factors responsible?

Subadults account for only 10.2% (23/226) of all aged individuals in the River Thames assemblage, which is considerably less than the 30% representation expected in archaeological assemblages formed under conditions of attritional mortality (Lewis, 2006). The under-representation of subadult remains in skeletal assemblages from archaeological contexts is a well-documented phenomenon across a wide range of time periods and locations, and is often attributed to post-depositional factors, including those relating to taphonomic processes and the low recovery potential of subadult bone (e.g., Goldstein, 1953; Howell, 1982; Walker et al., 1988; Jones and Ubelaker, 2001; Lewis, 2002).

Various intrinsic properties of subadult bones (e.g., small size, low bone mineral density, higher porosity) make them more susceptible to loss through taphonomic processes across a range of different burial environments. In fluvial environments, the smaller and more fragile subadult bones may be more susceptible to destruction through the physical abrasion and damage known to affect bones in riverine systems. Additionally, the fluvial transport potential of subadult bones may be greater, which could also account for their loss from riverine skeletal assemblages. Smaller, less dense, and lighter bones have been demonstrated to transport farther, faster, and more readily in moving water across multiple studies (Evans, 2014).

Recovery bias is also often cited as a reason for the under-representation of subadult bones in skeletal assemblages: their small size and different morphology means that they are less likely to be recognised as human bone, even by experienced excavators (Chamberlain, 2006:89; Lewis, 2006:26). This is potentially a highly relevant source of bias for the River Thames assemblage because, as aforementioned, the vast majority of the human remains were recovered by dredger crews. This bias is also likely to affect remains recovered more recently; as an example, one of the subadult frontal bones recovered from the Putney foreshore was at first thought by the finder to have been an animal bone (E. Wragg, pers.comm). Interestingly however, six of the total 23 subadult remains in the assemblage were recovered from the foreshore in recent years, possibly owing to the fact that many of the finders are purposefully searching for archaeological remains and have relevant identification skills. Subadults thus account

for 28.6% (6/21) of foreshore human remains, compared to 10.2% of the overall assemblage, a fact which potentially hints at the extent to which recovery bias may be responsible for their under-representation.

The post-depositional factors discussed above are very likely to have contributed to the apparent under-representation of subadult remains within the River Thames assemblage. It would be expected that both taphonomic and recovery factors would affect the youngest age groups the most, and this is the pattern which is apparent: there are no remains from individuals under the age of 2-4 years old.

Such post-depositional factors are also likely to be, perhaps in large part, responsible for the under-representation of subadult remains identified in other watery assemblages for which comparative data is available (see Table 7.1). For example, the Kessel (River Meuse) assemblage where subadults also only accounted for 10% of aged individuals was recovered through dredging and sieving (ter Schegget, 1999; see Table 7.1). The Eton Rowing Course palaeochannels, from which no subadults remains were recovered, were excavated under waterlogged conditions, which caused the excavators to speculate that small bones may not have been retrieved (Allen et al., 2000, see Table 7.1).

7.2.3.2 Interpreting the presence of subadults

As a result of the above discussion of the potential influence of post-depositional factors, placing too much interpretative focus on the under-representation of subadults in the River Thames assemblage, and at other watery sites, is perhaps best avoided. Instead, shifting focus instead to their presence within the assemblage may be a more fruitful avenue to explore, especially as higher numbers of subadults have been identified in the River Thames assemblage in the current study, in part due to the recovery of multiple subadult remains from the foreshore in recent years.

The presence of four Iron Age subadults may be of particular interest (see Table 7.3). Though not in time for inclusion in the present study, a further Middle Iron Age subadult frontal bone has also very recently been recovered from the foreshore in central London (J. Sidell, pers.comm). The fact that two of these Iron Age subadult individuals, and another undated individual, were recovered from the foreshore at Putney could also have implications for the processes of formation in that location (see discussion in Chapter 9). One calotte from Putney (FFW03, undated) had completely open sutures

between the frontal and both parietals, with each bone present as a separate fragment, which potentially indicates that the remains were recovered in-situ in their original place of deposition, though it is possible that the cranium could have undergone fluvial transport while still fleshed.

SK ID	Age-at-death category	Period	cal BC/AD (95% confidence)		Element	Location	Recovery method
SK 1516	12-17 years	Iron Age	-755	-420	Cranium	Battersea Bridge	Probably dredged (pre-1867)
SK 1529	12-17 years	Iron Age	-770	-420	Cranium	Thames	Probably dredged (pre-1922)
Putney 1	0-11 years (~6 years old)	Iron Age	-750	-400	Mandible	Putney	Foreshore find (2018)
GEN01 4856	Subadult (<18 years)	Iron Age	-400	-200	Cranial fragment	Putney	Foreshore find (2014)
FFW03	Subadult (<18 years)	Undated	NA	NA	Calotte	Putney	Foreshore find (2000s)

Table 7.3: The subadults in the River Thames assemblage with an Iron Age radiocarbon date. The table also includes an undated subadult additionally recovered from the Putney foreshore.

Although also under-represented in other watery assemblages (see Table 7.1), subadult remains are present at all, with the exception of Eton Rowing Course. This includes the watery sites which have been interpreted as having a strong relationship with conflict: La Téne, Weltzin 20, and Kessel (see Table 7.1, and Chapter 2 for descriptions of the sites). Subadults have also been identified among the Bronze and Iron Age bog bodies from Britain, widely considered to be intentional depositions in water (Stevens and Chapman, 2020).

7.3 Demography: Maynard Reservoir assemblage results

The 33 single and partially-articulated elements (counting re-fitting single elements as one partially-articulated element, e.g., a skull) which comprise the Maynard Reservoir assemblage are presented in Table 7.4, alongside their full corresponding age-at-death and sex data. Figure 7.4 provides a summary of the age-at-death and sex distribution of the Maynard Reservoir assemblage elements.

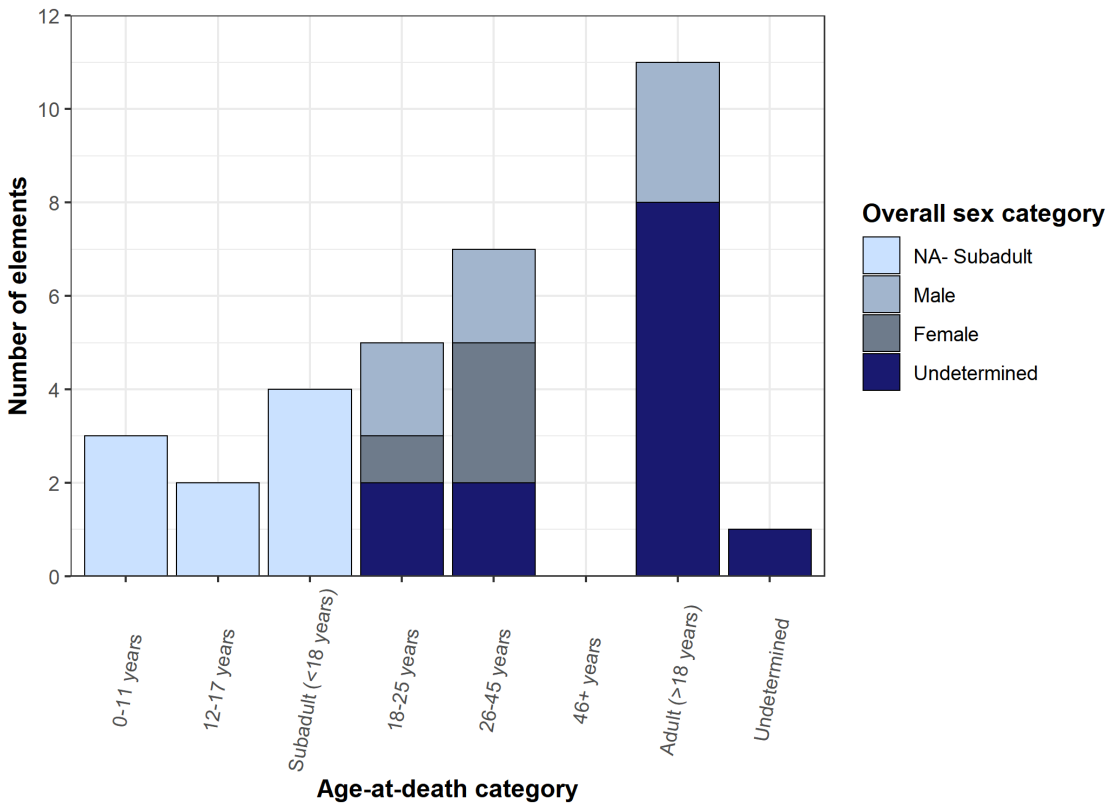

Figure 7.4: The overall age-at-death and sex structure of the Maynard Reservoir assemblage elements. The age-at-death categories form the X axis, and the bars are coloured according to the overall sex categories (lightest blue = NA- subadult, light blue = male, grey-blue= female, dark blue = undetermined). See Section 4.4.3 for information on the derivation of the overall sex categories.

Of the 33 elements, 23 belong to adults, nine to subadults, and one was of undetermined age-at-death. The proportion of subadult to adult elements is therefore 28.1% (9/32) to 71.9% (23/32). This proportion rises slightly when only the elements comprising the minimum number of individuals (MNI) are considered: the assemblage has an MNI of four subadults and eight adults, so the proportion of subadults increases to 33.3% (4/12). Among the subadult elements, the presence of at least one adolescent, one child aged around seven years old, and another aged between three and four years old can be identified. It is feasible that the three elements with an adolescent age-at-death (indicated with an asterisk in Table 7.4) represent a single individual, owing to the congruence in the age-at-death scores and the close anatomical positioning of the elements (e.g., humerii, scapula). The same case can be made for the two elements which produced an age-at-death between three and four years old (indicated with a cross in Table 7.4).

The majority of the adult elements, 47.8% (11/23), were assigned to the non-specific adult (>18 years) category. Of the remaining elements, 21.7% (5/23) were assigned to the younger adult 18-25 years category, and 30.4% (7/23) to the 26-45 years category. None of the remains were scored in the older adult category of 46+ years. Considering only the eight mandibular remains which were used to calculate the MNI and necessarily represent different individuals, three were young adults (18-25 years category), six middle aged adults (26-45 years category), and one was of non-specific age (>18 years category).

Of the 23 adult elements, it was not possible to estimate the sex of 10. Of the remaining elements, two were of intermediate sex, four were female, and seven were male. There is therefore a slight male bias if all elements are considered, of 63.6% male (7/11) to 36.4% female (4/11). However, of the eight mandibular remains, which were used to calculate the MNI and necessarily represent different individuals, three were female, four were male, and one was intermediate. This suggests males and females may actually be present in roughly equal proportion, and simply that a greater number of elements are present for some of the males. The sex of cranium SK 3311, of Late Bronze Age date (1110-900 cal BC), was genetically determined as female (see Appendix Table B.1). The other two dated remains were osteologically estimated to be probable female (SK 4191A, a mandible), and of intermediate sex (SK 4191, a cranium).

SK ID	**Radiocarbon date**	**Element**	**Age-at-death category**	**Age-at-death note**	**Osteological Sex**
4191A	1380-1050 cal BC	Mandible	18-25 years	NA	P. Female
3311A	NA	Mandible	Adult (>18 years)	NA	P. Male
4185	NA	Mandible	26-45 years	NA	Female
4188	NA	Mandible	26-45 years	NA	Intermediate
4189	NA	Mandible	18-25 years	NA	P. Male
4187	NA	Mandible	18-25 years	NA	P. Male
UNREG 8651 (Waltham 1)	NA	Mandible	26-45 years	NA	Male
4190 + 4197	NA	Skull	26-45 years	NA	P. Female
4191	1220-1055 cal BC	Cranium	26-45 years	NA	Intermediate
3311	1110-900 cal BC	Cranium	26-45 years	NA	Intermediate (genetic female)

SK ID	Radiocarbon date	Element	Age-at-death category	Age-at-death note	Osteological Sex
4196	NA	Frontal	Adult (>18 years)	NA	P. Male
4194	NA	Calotte	Adult (>18 years)	NA	P. Male
4201D	NA	L innominate	26-45 years	NA	Male
UNREG 8651 (Waltham 2)	NA	L parietal	Undetermined	NA	Undetermined
4199A	NA	L humerus	Adult (>18 years)	NA	Undetermined
4199B	NA	R humerus	Adult (>18 years)	NA	Undetermined
4201A	NA	L humerus	Adult (>18 years)	NA	Undetermined
4200B	NA	L radius	Adult (>18 years)	NA	Undetermined
4199C	NA	L radius	Adult (>18 years)	NA	Undetermined
UNREG Waltham 3	NA	L femur	Adult (>18 years)	NA	Undetermined
4201B	NA	L fibula	Adult (>18 years)	NA	Undetermined
4201E	NA	Atlas	Adult (>18 years)	NA	Undetermined
4201G	NA	2nd rib	18-25 years	NA	Undetermined
4201H	NA	Lower rib	18-25 years	NA	Undetermined
SUBADULT ELEMENTS					
4186*****	NA	Mandible	Subadult (<18 years)	12-21 years	NA-subadult
4200A*****	NA	L + R humerus	12-17 years	11-16	NA-subadult
4201C*****	NA	L scapula	12-17 years	15-18	NA-subadult
4198 **†**	NA	Skull	0-11 years	3-4 years	NA-subadult
4190 **†**	NA	Atlas + C3	0-11 years	3-4	NA-subadult
4192	NA	Skull	0-11 years	~7 years	NA-subadult
4193	NA	Calvarium	Subadult (<18 years)	NA	NA-subadult
4195	NA	Frontal	Subadult (<18 years)	NA	NA-subadult
4201F	NA	1st rib	Subadult (<18 years)	NA	NA-subadult

Table 7.4: The Maynard Reservoir assemblage elements, shown alongside their corresponding radiocarbon, age-at-death and sex data. Elements marked * are considered likely to belong to a single adolescent, and elements marked † to belong to a single 3-4 year old. In the “Osteological Sex” column, “P. Female” stands for probable female and “P. Male” for probable male. In relation to the elements, “L” is used to denote left and “R” to denote right.

7.4 Demography: Maynard Reservoir assemblage discussion

7.4.1 An attritional mortality profile?

The age-at-death structure of the Maynard Reservoir assemblage does not appear to closely resemble that which would be expected under conditions of natural attritional mortality, where higher numbers of infant and older adult individuals would be expected (Chamberlain, 2009).

The proportion of subadults to adults is 28.1% (9/32) to 71.9% (23/32) on the basis of all elements, and 33.3% (4/12) to 66.7% (8/12) on the basis of the elements used to calculate the MNI. These figures are around the 30% representation benchmark for subadults in archaeological assemblages formed under conditions of attritional mortality (Lewis, 2006:22). However, younger children and infants under the age of five years, who would be expected to have the highest mortality and therefore to be present in the assemblage in greater numbers (Chamberlain, 2006), are represented only by two elements aged 3-4 years old, probably from one individual (elements SK 4198 and SK 4190; see Table 7.4). It is possible that the assemblage has lost the remains of younger subadults through similar taphonomic and recovery bias processes as already discussed in relation to the River Thames assemblage (see Section 7.2.3.1). However, the Maynard Reservoir assemblage was recovered through excavation, rather than dredging, and some very small subadult bones were recovered (e.g., SK 4190, subadult vertebrae). Taphonomic factors are important to consider though. The presence of multiple articulating elements suggests that the assemblage has not been subject to extensive fluvial disturbance. However, animal scavenging is a relevant factor to consider, as infant and juvenile remains are more likely to be removed from skeletal assemblages via scavenging (McKinley, 2017) and animal gnawing marks are present on some elements in the Maynard Reservoir assemblage (see Section 6.4.1.3.3). To summarise, it is unclear whether the lack of younger subadult remains reflects the assemblage as originally deposited, or taphonomic and recovery factors.

The adult age-at death structure of the assemblage also deviates from that expected in attritional mortality profiles, where the numbers of adults should increase with increasing age-at-death (Chamberlain, 2006). In the Maynard Reservoir assemblage, younger and middle aged adults comprise the totality of the elements which could be assigned a specific age-at-death, and there is a complete absence of older adult elements (Figure 7.4). However, in relation to this pattern it is important to highlight that

archaeological assemblages aged using osteological methods often demonstrate unexpected peaks in young and middle adult mortality, possibly owing to systematic methodological biases towards under-estimating age-at-death in older individuals (Buikstra and Konigsberg, 1985; Aykroyd et al., 1999; Chamberlain, 2006:90). Furthermore, it is worth considering how these age categories would have applied to prehistoric populations, which likely had significantly lower average life expectancies (Chamberlain, 2006:90).

7.4.2 A catastrophic mortality profile?

Having established that the demographic profile of the Maynard Reservoir assemblage does not closely resemble that which would be formed under attritional mortality conditions, it is worth considering the extent to which it may represent an episode of catastrophic mortality, i.e., a short-term high mortality event such as a natural disaster, episode of violence, or disease (Chamberlain, 2006). Catastrophic mortality profiles may closely resemble the demographic structure of the living population, in cases where all individuals have an equal risk of death regardless of age or sex (Gowland and Chamberlain, 2005).

It can be argued that the Maynard Reservoir assemblage is a fairly representative cross-section of the demographic structure of a small later prehistoric community. The subadult remains cover an even spread of ages: including a 3-4 year old, a 7 year old, and an adolescent (Table 7.4). The presence of adolescent remains is particularly pertinent, as this age group has the lowest mortality risk under conditions of attritional mortality (Chamberlain, 2006), and consequently adolescent remains are generally rare in archaeological assemblages. The adult remains present a balance of male and female, young and middle aged individuals, which would also be the expected pattern in a small living community. The absence of infant and older adult remains in the assemblage may also be consistent with the concept of a catastrophic mortality profile, as these age groups have the highest underlying mortality risk, and therefore may not be expected to have had a consistent presence in small prehistoric populations (e.g., Willey and Emerson, 1993).

7.5 Demography summary

To summarise, the demographic analysis of the River Thames assemblage has revealed a strong bias towards male individuals: males represented 71.6% (111/155) of sexed individuals, and females only 28.4% (44/155). An examination of the post-depositional factors which could account for an element of this bias was conducted, with the assistance of the genetic sex data available for a subset of individuals, and it was concluded that the male bias can be considered to be a real feature of the River Thames assemblage. Subadults were identified as being under-represented in the River Thames assemblage, representing only 10.2% (23/226) of individuals assigned a specific age-at-death. It was considered likely that post-depositional factors could be highly relevant to this pattern.

The demographic profile of the Maynard Reservoir assemblage does not appear to represent an attritional mortality profile, though post-depositional factors are relevant to consider in relation to this. Instead, it was considered that the demographic profile could represent a catastrophic mortality profile. These patterns are discussed further in Chapter 9, along with the aspects of the data presented in other chapters.

7.6 Violence-related trauma: River Thames assemblage results

7.6.1 Overall patterning

A high prevalence of violence-related trauma was observed in the River Thames assemblage. Fifty-one of the individuals examined presented evidence of trauma (see Section 4.5.2), giving a crude trauma prevalence of 22.9% (51/223). The distribution of trauma-affected individuals by demographic grouping is presented in Table 7.5. All affected individuals were adults, with the exception of three subadults. Of the adult individuals, 72.9% (35/48) were males, 10.4% (5/48) were females, and 16.7% (8/48) were of undetermined sex. Ten of the males, and one of the females, were identified genetically. For the overall assemblage, the crude prevalence of trauma in males was 32.1% (35/109), and 12.5% in females (5/40).

Age-at-death			Sex					
Category (years)	***n***	***n* affected (%)**	**Males**		**Females**		**Undetermined**	
			n	***n* affected (%)**	***n***	***n* affected (%)**	***n***	***n* affected (%)**
0-11	**4**	**0 (0.0%)**	X	X	X	X	X	X
12-17	**4**	**1 (25.0%)**	X	X	X	X	X	X
Subadult (<18)	**13**	**2 (15.4%)**	X	X	X	X	X	X
18-25	**19**	**4 (21.1%)**	10	4 (40.0%)	7	0 (0.0%)	2	0 (0.0%)
26-45	**66**	**18 (27.3%)**	34	12 (35.3%)	16	2 (12.5%)	16	4 (25.0%)
46+	**36**	**11 (30.6%)**	25	10 (40.0%)	5	0 (0.0%)	6	1 (16.7%)
Adult (>18)	**74**	**15 (20.3%)**	40	9 (22.5%)	12	3 (25.0%)	22	3 (13.6%)
Undetermined	**7**	**0 (0.0%)**	0	0 (0.0%)	0	0 (0.0%)	7	0 (0.0%)
Total *n* individuals	**223**	**51 (22.9%)**	**109**	**35 (32.1%)**	**40**	**5 (12.5%)**	**53**	**8 (15.1%)**

Table 7.5: The distribution of trauma-affected individuals in the River Thames assemblage according to age-at-death and sex categories. The percentages given in brackets (%) are the crude trauma prevalences for that particular age-at-death and sex combination, calculated as the number of affected individuals (*n* affected), divided by the total number of observable individuals (*n*).

A total of 83 separate traumatic lesions were identified, 72 with high probability and 11 with mid probability. The lesions were fairly evenly distributed in type and timing, which is presented in Figure 7.5. In terms of timing, the majority of injuries were perimortem (56.6%; 47/83), as opposed to antemortem (43.4%; 36/83). Sharp force and blunt force injuries were the most commonly encountered trauma types, and were present in almost equal proportions, with 37 (44.6%; 37/83) sharp force injuries and 39 (47.0%; 39/83) blunt force injuries. However, for injuries of perimortem timing, sharp force injuries account for 51.1% (24/47) and blunt force 38.3% (18/47); while the pattern is reversed for injuries of antemortem timing, with sharp force injuries only accounting for 36.1% (13/36) and blunt force for 58.3% (21/36). Two instances of antemortem trepanation were identified.

Of the 51 individuals affected by trauma, 55.0% (28/51) presented perimortem injuries, 41.2% (21/51) presented antemortem injuries, and 3.9% (2/51) presented both perimortem and antemortem injuries. For the overall assemblage this provides crude prevalences of 13.5% (30/223) for perimortem trauma, and 10.3% (23/223) for antemortem trauma.

Sixteen individuals, almost a third of affected individuals, presented more than one traumatic lesion (31.4%; 16/51). Seven of these individuals were affected by perimortem injuries, seven by antemortem injuries, and two by both perimortem and antemortem injuries.

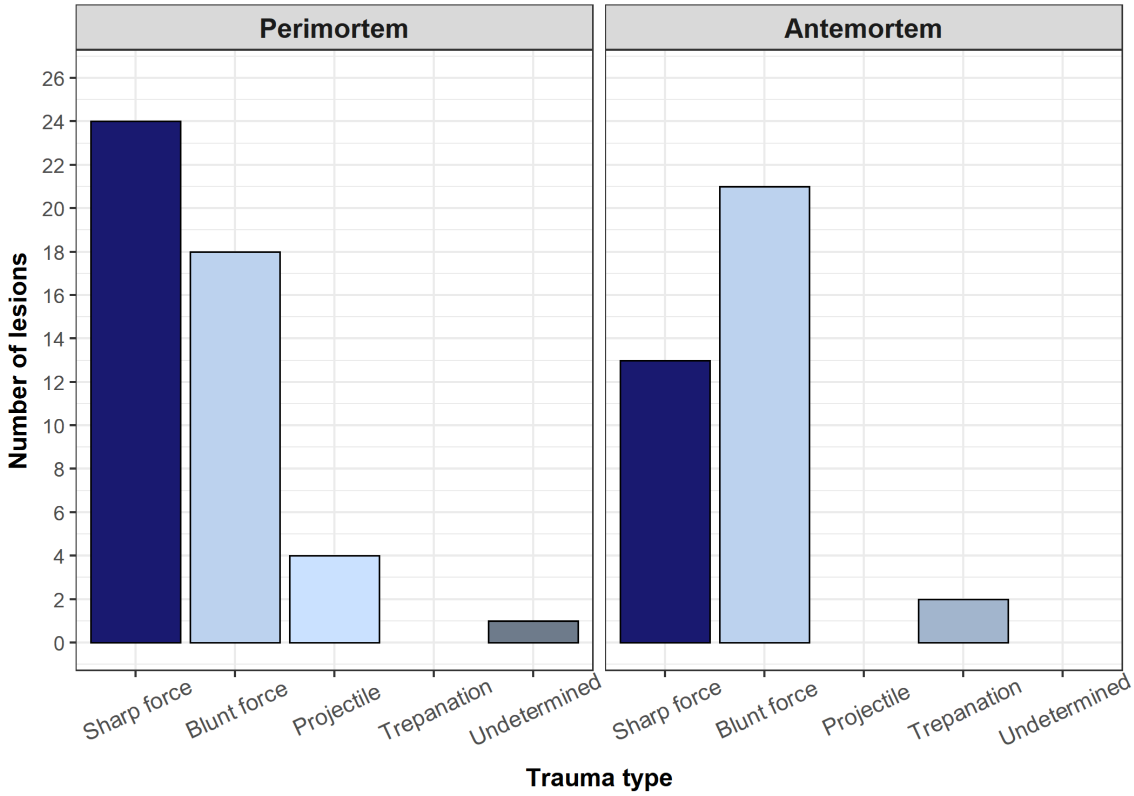

Figure 7.5: The traumatic lesions identified in the River Thames assemblage. The lesions are presented by timing (left panel= perimortem lesions, right panel = antemortem lesions) and type (sharp force, blunt force, projectile, trepanation, undetermined).

The distribution of trauma by bone element is presented in Table 7.6. Trauma was only identified in elements of the skull (post-cranial elements were only observable for four individuals). The left parietal, right parietal, and frontal were the bones most affected by trauma. These bones had the highest individual lesion counts, and also the highest true prevalence trauma rates of 11.1% for the left parietal bone, 9.7% for the right parietal bone, and 8.1% for the frontal bone (Table 7.6).

Bone	*n* lesions	*n* affected	Total *n*	TPR
Frontal	19	16	198	8.1%
R Parietal	23	19	196	9.7%
L Parietal	28	22	199	11.1%
Occipital	2	2	176	1.1%
R Temporal	2	2	114	1.8%
L Temporal	2	1	106	1.0%
Mandible	6	1	14	7.1%
R Zygomatic	1	1	44	2.8%
L Zygomatic	0	0	37	0%
R Maxilla	0	0	47	0%
L Maxilla	0	0	43	0%
Sphenoid	0	0	109	0%

Table 7.6: The distribution of trauma in the River Thames assemblage by bone element. The number of individual lesions present on each bone type is given in the first column (*n* lesions). The true prevalence of trauma for each bone element is given in the final column (TPR). This percentage is calculated as the number of bones affected (*n* affected), divided by the total number of observable bones (Total *n*). In the "bone" column, "L" refers to left and "R" refers to right.

7.6.2 River Thames assemblage: temporal and spatial patterns

7.6.2.1 Overview

Eighteen of the 51 trauma-affected individuals, just over a third, currently have associated radiocarbon dates. These individuals are outlined in Table 7.7, along with their associated contextual information and information about the nature of their lesions. Table 7.8 presents a summary of the crude prevalence of trauma and the affected demographics by time period.

Eight of the radiocarbon dates for the trauma-affected individuals were provided for the first time in this study, and have revealed the presence of two Late Bronze Age individuals, four additional Iron Age individuals, one Roman period individual and one Post-Medieval individual.

SK ID	Location	Zone	cal BC/AD (95% confidence)		New date?	Age-at-death (years)	Sex	Lesion type	Lesion timing	Affected bone	Probability
GEN01 52	Syon Reach	B	-2460	-2140	No	>18	Female*	BF	AM	R Parietal	High
								SF	AM	L Parietal	High
								SF	AM	L Parietal	High
								SF	AM	L Parietal	High
								SF	AM	Occipital	High
GEN01 59	Chelsea	E	-1870	-1610	No	>18	Male	TREP	AM	Frontal	High
								UNDET	PM	Frontal	Mid
UNREG 1414	Battersea	E	-1200	-1010	Yes	26-45	Male*	SF	AM	L Parietal	High
SK 4073	Mortlake	C	-970	-825	Yes	>18	Male*	BF	PM	L Parietal	High
SK 1520	Battersea Bridge	E	-770	-420	No	26-45	P. Female	PROJ	PM	L Parietal	High
SK 1529	Thames	T	-770	-420	No	12-17	NA- subadult	PROJ	PM	R Parietal	High
SK 4069	Mortlake	C	-750	-400	No	26-45	P. Male	PROJ	PM	L Parietal	High
SK 1506	Mortlake	C	-730	-405	Yes	46+	Male*	SF	AM	Frontal	High
SK 4168	Battersea	E	-410	-210	No	>18	P. Male	BF	PM	L Parietal	High
SK 1514	Chelsea Bridge	E	-400	-230	Yes	26-45	Male*	SF	PM	L Parietal	High
								SF	PM	R Parietal	High
								SF	PM	R zygomatic	High
SK 4074	Mortlake	C	-400	-200	Yes	46+	Male*	BF	AM	Frontal	High
GEN01 51	Putney	D	-390	-200	No	46+	Male*	BF	AM	L Parietal	High
								BF	AM	R Parietal	High

SK ID	Location	Zone	cal BC/AD (95% confidence)		New date?	Age-at-death (years)	Sex	Lesion type	Lesion timing	Affected bone	Probability
								BF	AM	R Parietal	High
SK 1558	Waterloo	F	-50	65	Yes	26-45	Male*	SF	PM	L Temporal	High
								SF	PM	L Temporal	High
SK 4120	Wandsworth	D	-40	130	No	46+	Male*	BF	AM	Frontal	High
								BF	AM	L Parietal	High
SK 1518	Battersea Bridge	E	65	210	Yes	18-25	Male*	BF	AM	Frontal	High
GEN01 31	Kew	B	890	1030	No	18-25	Male	SF	PM	L Parietal	High
								SF	PM	L Parietal	High
								SF	PM	L Parietal	High
								SF	PM	L Parietal	High
								SF	PM	L Parietal	High
GEN01 43	Barn Elms	C	1220	1280	No	26-45	P. Male	PROJ	PM	Frontal	High
SK 1549	Poplar	G	1520	1665	Yes	26-45	Male*	BF	AM	Frontal	High

Table 7.7: The 18 trauma-affected individuals in the River Thames assemblage with radiocarbon dates. If the radiocarbon date was obtained in this study, this is indicated with “Yes” in the “New date?” column. An asterisk in the “Sex” column indicates a genetic sex determination, those without are osteologically-determined. In the “Lesion type” column “BF”= blunt force, “SF”= sharp force, “PROJ”= projectile, “TREP”= trepanation, “UNDET”= undetermined. In the “Lesion timing” column “AM”= antemortem, “PM”= perimortem. The letter given in the “Zone” column refers to the section of the river from which the individual was recovered, as described in Section 4.1.1.2.4.

The majority of dated individuals belong to the Iron Age, and this period also has the highest crude prevalence of trauma at 64.3%, with nine out of the 15 individuals examined with an Iron Age date presenting evidence of trauma. The Bronze Age is the second best-represented period in terms of the number of individuals affected (four), but has a lower crude prevalence of 26.7%. The Neolithic is the only period with no identified cases of trauma, though only four dated individuals are currently identified.

The male bias in affected individuals was present in all time periods and among the undated individuals. One female (genetically identified) was present among the Bronze Age individuals, and another (osteologically identified) was present among the Iron Age individuals. An adolescent (SK 1529, aged 12-17 years) is the only of the three trauma-affected subadults with a radiocarbon date, and belongs to the Early Iron Age.

Period	***n* affected individuals**	***n* individuals examined**	**% crude prevalence**	**Demography of affected individuals (*n*)**			
				Male	**Female**	**Subadult**	**Undet'**
Neolithic	0	4	0%	-	-	-	-
Bronze Age	4	15	26.7%	3	1	0	0
Iron Age	9	14	64.3%	7	1	1	0
Roman	2	4	50.0%	2	0	0	0
Medieval	2	9	22.2%	2	0	0	0
Post-Medieval	1	5	20.0%	1	0	0	0
Undated	33	172	19.2%	20	3	2	8
Total *n*	**51**	**223**	**22.9%**	**35**	**5**	**3**	**8**

Table 7.8: The distribution of trauma in the River Thames assemblage by time period, alongside demographic data. The crude prevalence of trauma for each time period (% crude prevalence) is calculated as the number of individuals affected by trauma in a particular time period (*n* affected individuals), divided by the total number of individuals observed for that time period (*n* individuals examined). The demographic distribution of the trauma-affected individuals within each time period is presented in the final column (Demography of affected individuals (*n*)). "Undet" refers to individuals of undetermined sex.

The spatial distribution of the trauma-affected individuals is presented in Table 7.9, where the numbers of affected individuals are shown for each Thames zone (A-H and Thames, see Section 4.1.1.2.4) alongside the crude prevalence of trauma for each

zone. The temporal distribution of individuals within each river zone is also given. Zone C (Mortlake to Hammersmith) had the highest number of trauma-affected individuals (14 individuals) but not the highest crude prevalence, as 70 individuals from this zone were examined. Zone D (Putney to Wandsworth) and zone E (Battersea/Chelsea) had particularly high crude prevalences, of 43.8% and 53.3%, respectively. Of the 33 undated individuals, the majority (13 individuals) belonged to the general "Thames" location group, with high numbers also present in zone C (nine individuals) and zone D (five individuals).

Thames zone	***n* affected individuals**	***n* individuals examined**	**% crude prevalence**	**Period of affected individuals (*n*)**					
				BA	**IA**	**R**	**M**	**PM**	**U**
A: West outliers	0	4	0%	-	-	-	-	-	-
B: Richmond-Kew	4	16	25%	1	0	0	1	0	2
C: Mortlake - H'smith	14	70	20.0%	1	3	0	1	0	9
D: Putney-W'worth	7	16	43.8%	0	1	1	0	0	5
E: Battersea/ Chelsea	8	15	53.3%	2	3	1	0	0	2
F: Central London	2	15	13.3%	0	1	0	0	0	1
G: Isle of Dogs	2	9	22.2%	0	0	0	0	1	1
H: East Outliers	0	4	0%	-	-	-	-	-	-
Thames	14	74	18.9%	0	1	0	0	0	13
Total *n*	**51**	**223**	**22.9%**	**4**	**9**	**2**	**2**	**1**	**33**

Table 7.9: The spatial distribution of trauma affected individuals in the River Thames assemblage, presented by Thames zone. See Section 4.1.1.2.4 and Figure 5.2 for information on zones. The crude prevalence of trauma for each Thames zone (% crude prevalence) is calculated as the number of individuals affected by trauma in a particular zone (*n* affected individuals), divided by the total number of individuals observed for that time period (*n* individuals examined). The temporal distribution of the trauma-affected individuals within each zone is presented in the final column (Period of affected individuals (*n*)). "BA"= Bronze Age, "IA"= Iron Age, "R"= Roman, "M"= Medieval, "PM"= Post-Medieval, "U"= undetermined.

7.6.2.2 Trauma by time period

In the following sections, descriptions of the trauma-affected individuals are provided by time period. First, the Bronze Age trauma-affected individuals are described, followed by the Iron Age, the Roman period, the Medieval period, the Post-Medieval period, and then a summary of the undated individuals is provided.

7.6.2.2.1 The Bronze Age (c. 2300-800 BC)

Four of the Bronze Age individuals presented traumatic injuries, giving the Bronze Age a trauma prevalence of 26.7% (trauma present in 4/15 individuals examined). All of the affected individuals were adults. Three were males (two genetically identified), and one was a female (one genetically identified).

Early Bronze Age

The earliest of these in date is a calvarium recovered from Syon Reach (GEN01 52), with an Early Bronze Age date (2460-2140 cal BC). This individual is a genetic female and presented five separate antemortem injuries: four healed sharp-force injuries (Figure 7.6, 1-4) and one healed blunt force injury (Figure 7.6, 5). They also had a series of fine linear incisions on the right temporal bone, which could represent cut marks. However closer, microscopic examination would be needed in order to rule out the possibility of post-recovery damage (e.g., damage from sanding in historical curation efforts (see White and Toth, 1989). A potential differential diagnosis for some of the sharp force lesions, particularly 1 and 2 could be aborted trepanations, as hypothesised for a series of injuries with similar patterning on a Late Neolithic female cranium from Germany (Nicklisch et al., 2018).

Figure 7.6: GEN01 52, an early Bronze Age female calvarium recovered from Syon Reach. Three antemortem sharp force lesions were present on the left parietal bone (1-3), and another was present on the left posterior aspect of the occipital bone (4). An antemortem blunt force injury was present on the posterior aspect of the right parietal bone (5). © Museum of London.

GEN01 59 is a male calotte recovered from the foreshore at Chelsea in 2001, and is also Early Bronze Age in date (1870-1610 cal BC). This individual had a large healed trepanation on their frontal bone, positioned on the superior aspect and to the left of the midline (Figure 7.7). The morphology of the lesion, particularly the oval shape and broad, shallow, external bevel suggests that this was performed using a scraping technique (Aufderheide and Rodríguez-Martín, 1998:33). Based on its morphology, the most likely differential diagnosis for the lesion would be an antemortem sharp force injury; however, large healed penetrative inuries are rare owing to the risk of brain injury and infection (Verano, 2017:115). This individual also presented a possible large perimortem injury to the posterior portion of the cranium, which is inferred from multiple fracture lines with clear perimortem characteristics (e.g., smooth walls, sharp edges,

consistent taphonomic patina). Owing to the incompleteness of the calotte this is only identified as a mid-probability lesion, and the causal mechanism cannot be determined.

Figure 7.7: Anterior (top image) and superior (lower image) views of GEN01 59, an Early Bronze Age male calotte recovered from Chelsea. This individual presented a large antemortem trepanation on the superior left aspect of their frontal bone. The white arrow indicates the trepanation aperture, the black arrows indicate the outer limits of the external bevel. © Museum of London.

Late Bronze Age

Two Late Bronze Age individuals, both provided with radiocarbon dates for the first time in this thesis and both genetic males, presented traumatic injuries. UNREG 1414, a cranium from Battersea radiocarbon dated 1200-1010 cal BC had an antemortem sharp force injury to the superior left side of the cranium (Figure 7.8). This was a fine linear incision which originated slightly anterior to the coronal suture, and extended in a superior-posterior direction before terminating on the left parietal. The morphology of this lesion suggests it could have been caused by a small bladed weapon, such as a knife or a dagger (Lewis, 2008).

Figure 7.8: Antemortem sharp force injury on the left parietal bone of UNREG 1414, a Late Bronze Age male cranium recovered from Battersea. © The Trustees of the Natural History Museum, London.

SK 4073, a calvarium from Mortlake radiocarbon dated 970-825 cal BC, had a substantial perimortem blunt force injury to the superior aspect of their cranium (Figure 7.9). This lesion was a square-shaped complete fracture which had penetrated both the ecto- and endocranial surfaces of the superior aspect of the parietal bones, just posterior to bregma. Three radiating fractures and internal bevelling were present.

Figure 7.9: Perimortem blunt force injury to the superior cranial vault of SK 4073, a Late Bronze Age male calvarium recovered from Mortlake. Three radiating fractures are present (indicated with black arrows). © The Trustees of the Natural History Museum, London.

7.6.2.2.2 The Iron Age (c. 800 BC- AD 43)

Nine Iron Age individuals presented traumatic injuries, giving a trauma prevalence of 64.3% for the Iron Age (trauma present in 9/14 individuals examined). Four of these individuals were radiocarbon dated to the Early Iron Age, four to the Middle Iron Age, and one to the Late Iron Age. All but one of the affected individuals were adults, the other was an adolescent (SK 1529). Of the adult individuals, seven were males (five of these confirmed genetically) and one was a probable female. Six individuals presented perimortem trauma, and three presented antemortem trauma.

Early Iron Age

Three of the four Early Iron Age individuals presented single perimortem projectile injuries. SK 1520 and SK 1529, both radiocarbon dated 770-420 cal BC, presented perimortem projectile injuries with very similar morphologies. SK 1520, a probable female cranium recovered from Battersea Bridge, had a diamond-shaped perimortem perforating projectile injury to the superior aspect of their left parietal bone, just posterior to the coronal suture (Figure 7.10). The layers of cranial bone were completely penetrated, internal bevelling was observed, and delamination was present along the posterior margins of the lesion. SK 1529, an adolescent cranium aged 12-17 years with a general Thames location, presented an oval shaped perimortem projectile injury to the superior aspect of the right parietal bone (Figure 7.11). As with SK 1520, the bone was completely penetrated, and internally bevelled. Delamination was also observable along the lateral margin of the lesion.

These injuries are hypothesised to be projectile trauma primarily on the basis of their shape, and the presence of delamination. Projectile injuries are often “patterned”- i.e., they mimic the shape of the causal weapon (Kimmerle and Baraybar, 2008; Forsom and Smith, 2017). The diamond/oval shape and size of these injuries is highly consistent with the cross-section of spears, a commonly-used class of projectile weaponry in Iron Age Europe (Wells, 2020), though they could also be consistent with an arrowhead. Delamination of bone at the entrance site may be encountered in projectile injuries, as the bone is crushed at the point of impact (Steadman, 2008). However, in the absence of an embedded weapon, the differential diagnoses for these injuries are sharp force penetrating trauma, or blunt force crushing injuries.

Figure 7.10: Perimortem projectile injury on the left parietal bone of SK 1520, an Early Iron Age probable female cranium recovered from Battersea Bridge. © The Trustees of the Natural History Museum, London.

Figure 7.11: Perimortem projectile injury on the right parietal bone of SK 1529, an Early Iron Age adolescent cranium with a general “Thames” recovery location. N.B., the bone is lighter at the lateral margin owing to the presence of fine concretions from the burial environment. © The Trustees of the Natural History Museum, London.

The other Early Iron Age individual with perimortem projectile trauma was SK 4069, a probable male cranium recovered from Mortlake radiocarbon dated 750-400 cal BC. This individual presented a small oval perforation (5.5 mm diameter) to their posterior left parietal bone, which was internally bevelled and had a small amount of delamination at the margin (Figure 7.12). The presence of internal bevelling indicated its perimortem status, as opposed to being a postmortem modification. The absence of tool marks on the walls of the lesion means it is unlikely to represent trepanation (Verano, 2017). The overall morphology of the lesion is similar to that produced by arrowheads or slingstones elsewhere (e.g., Redfern, 2009; Forsom and Smith, 2017; Zhan et al., 2019). The differential diagnosis in this case would be penetrating sharp force trauma, caused by a weapon with a circular cross section (e.g., a spear ferrule, or awl (e.g., Dittmar et al., 2019)). Interestingly, very similar perforations have been identified in the frontal bone of a Late Iron Age individual recovered from the River Meuse in the Netherlands (ter Schegget, 1999) and the River Wear in Britain (Parry, 1921).

Figure 7.12: Perimortem projectile injury on the posterior left aspect of the parietal bone of SK 4069, an Early Iron Age probable male cranium recovered from Mortlake. The right image is an endocranial view of the lesion demonstrating internal bevelling (affected area indicated by black arrows) and a consistent taphonomic patina with the surrounding bone, features which indicate the perimortem status of the lesion. © The Trustees of the Natural History Museum, London.

The fourth Early Iron Age individual affected by trauma is SK 1506, a genetic male cranium from Mortlake radiocarbon dated 730-405 cal BC. This individual presented an antemortem sharp force lesion on the right side of their frontal bone (Figure 7.13). The presence of one very straight margin (the inferior margin) and one curved margin (the superior margin), could indicate the lesion was produced by a sword or similar weapon (Lewis, 2008).

Figure 7.13: Antemortem sharp force injury on the anterior aspect of the right frontal bone of SK 1506, an Early Iron Age male calvarium recovered from Mortlake. © The Trustees of the Natural History Museum, London.

Middle Iron Age

Four of the trauma-affected individuals had a Middle Iron Age date. Two of these individuals presented perimortem trauma, and two presented antemortem trauma.

SK 1514, a genetic male cranium recovered from Chelsea Bridge and radiocarbon dated 400-230 cal BC, presented three perimortem sharp force injuries: 1) penetrating sharp force trauma on the left parietal bone; 2) a V-shaped insertion on the inferior margin of the right orbit, and; 3) a linear cut across the right posterior parietal bone (Figure 7.14). The penetrating trauma (1) closely resembles a slot fracture, presenting one straight margin, and one curved/irregular edge. Such fractures typically occur in stabbing injuries where a blade is rotated, and moved up and down, upon penetration and extraction (Kimmerle and Baraybar, 2008:268). Substantial inward displacement (hinging) was observable on the endocranial aspect of (1). The associated concentric and radiating fractures suggest impact with excessive force (Passalacqua and Fenton, 2012).

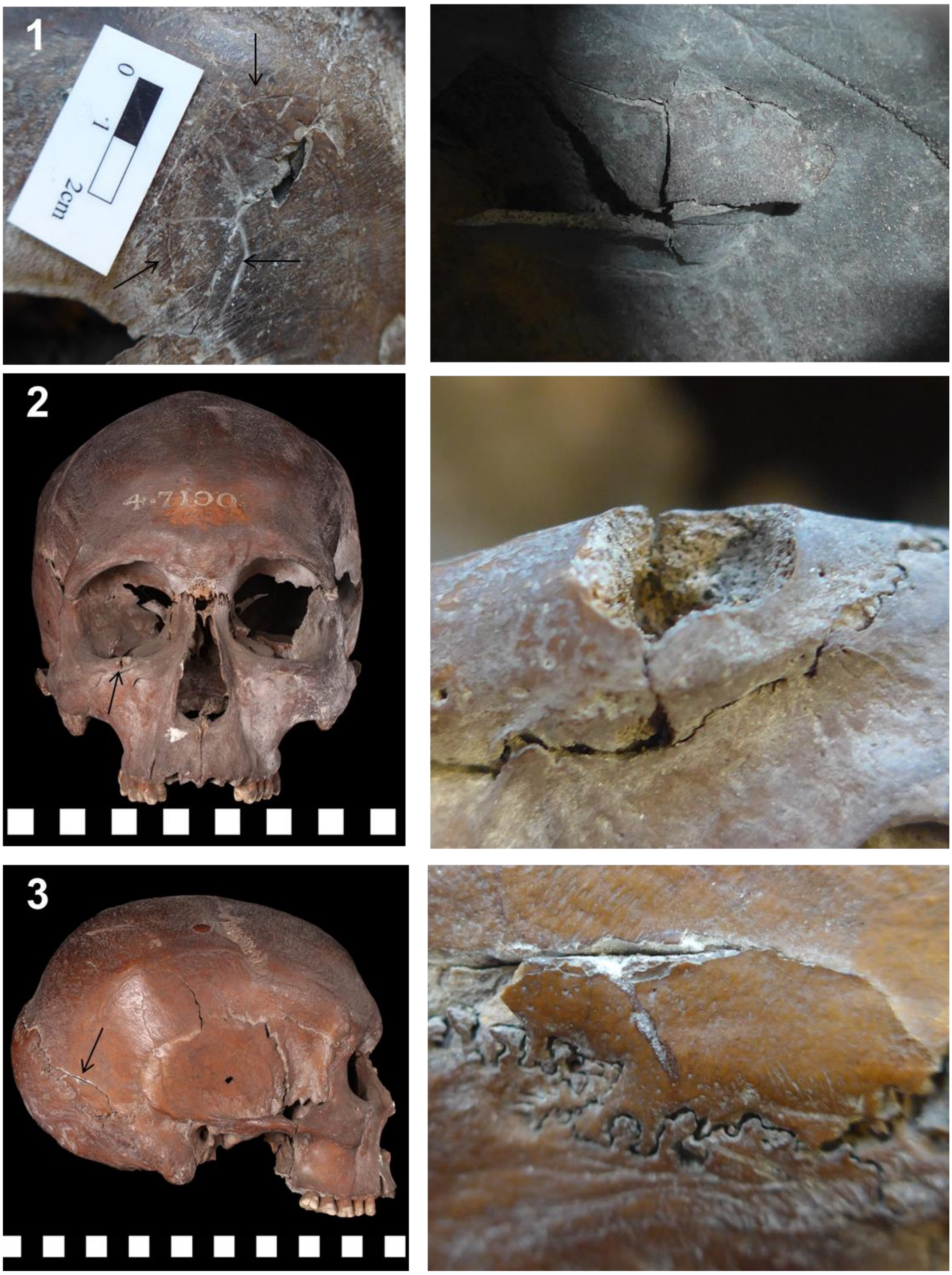

Figure 7.14: Three perimortem sharp force injuries on SK 1514, a Middle Iron Age male cranium recovered from Chelsea Bridge. Injury 1) is presented in the top images and was a penetrating sharp force injury located on the left parietal bone, presenting concentric and radiating fractures on the ectocranial surface (top left image, indicated with black arrow) and internal bevelling on the endocranial surface (top right image). Injury 2), middle images, was located on the inferior margin of the right eye orbit. Injury 3), bottom images, was located on the posterior right parietal bone. N.B., the bone is lighter in the centre of the lesion owing to the presence of fine concretions from the burial environment. © The Trustees of the Natural History Museum, London.

Further perimortem trauma was observed on SK 4168, a probable male calotte from Battersea radiocarbon dated 410-210 cal BC. This individual presented a large perimortem blunt force injury to the left side of their cranial vault.

Two Middle Iron Age individuals presented antemortem blunt force trauma. GEN01 51, (390-200 cal BC) a genetic male cranium recovered from the foreshore at Putney, presented three separate healed blunt force injuries. SK 4074 (400-200 cal BC) from Mortlake presented a single antemortem blunt force injury on their left frontal bone.

Late Iron Age

A single Late Iron Age individual, SK 1558 (50 cal BC- cal AD 65) a genetic male calvarium recovered from Waterloo, presented traumatic injuries. This individual had two small perimortem cut marks on their left temporal bone (Figure 7.15). The positioning of these cuts on the attachment site for the temporalis muscle is possibly indicative of mutilation: potentially the removal of ear given their positioning (Western and Hurst, 2013; Geber, 2015). The precision of the cuts, both in terms of their placement on the muscle attachment ridge and their consistent appearance, suggests that the individual was immobile when the wounds were inflicted (e.g., restrained, unconscious, dead).

Figure 7.15: Two perimortem cut marks on the left temporal bone of SK 1558, a Late Iron Age male cranium recovered from Waterloo. © The Trustees of the Natural History Museum, London

7.6.2.2.3 The Roman period (c. AD 43-410)

Two individuals dated to the Roman period presented evidence of trauma, giving this period a trauma prevalence of 50.0% (trauma present in 2/4 Roman period individuals examined). Both were genetic males, and presented antemortem blunt force injuries. SK 4120 (40 cal BC- cal AD 130), a calvarium from Wandsworth, presented two healed depressed fractures: one above their left orbit, and one on their left parietal. SK 1518 (cal AD 30-130) presented a large healed depressed fracture on the right side of their frontal bone.

7.6.2.2.4 The Medieval period (c. AD 410-1540)

Two individuals dated to the Medieval period presented evidence of trauma, giving this period a trauma prevalence of 22.2% (trauma present in 2/9 individuals examined). Both of these individuals were males, and presented perimortem injuries.

The earliest of these is GEN01 31, a male cranium from Kew radiocarbon dated to cal AD 890-1030, the Early Medieval period. This individual presented a series of five perimortem sharp force injuries across the left side of the cranial vault (Figure 7.16). It is hypothesised that these lesions were caused by a sword or similar weapon. Three of the lesions have one smooth, curved, wall (the obtuse angled side) and one straighter wall with flaking of bone (the acute angled side), which is a cross-sectional morphology unique to sword marks in experimental studies (Lewis, 2008). The angle of entry of the weapon into the bone surface clearly changes throughout the assault: in lesion 1 the blade has formed an acute angle with the bone surface towards the front of the body, in lesions 2 and 3 the acute angle is towards the posterior, and in lesion 4 the blade has struck the bone at a shallow angle and removed a roundel of bone. The positioning of the blows may indicate that the victim may have been being struck from above (e.g., by someone on horseback) and that the victim and/or the perpetrator were moving during the attack.

Figure 7.16: GEN01 31, a Medieval period male cranium recovered from Kew, with a series of perimortem sharp force injuries on the left parietal. © Museum of London.

GEN01 43, a probable male cranium from Barn Elms is slightly later in date (cal AD 1220-1280), and has a single perimortem projectile injury on the superior aspects of the left frontal bone. The morphology of the lesion (e.g., unilateral flaking of bone) is similar to that produced by medieval arrowheads in experimental studies (Forsom and Smith, 2017).

Post-Medieval

Trauma was present on only one Post-Medieval individual, giving this period a trauma prevalence of 20% (trauma present in one out of five individuals examined). SK 1549 (cal AD 1635-1800), a genetic male cranium recovered at Poplar presented a single antemortem depressed fracture to their left frontal bone, just above the eye orbit.

7.6.2.2.5 The undated individuals

Thirty-three undated individuals were affected by trauma, and these are listed in Table 7.10 alongside contextual information and information on the nature of the lesions identified. Twenty of the undated individuals were adult males. Nineteen individuals presented perimortem injuries, 13 presented antemortem injuries, and one presented both perimortem and antemortem injuries. Several individuals are described in full below owing to the uniqueness of their trauma patterns.

SK ID	Location	Zone	Age-at-death (years)	Sex	Lesion type	Lesion timing	Affected bone	Probability
GEN0126	Brentford	B	18-25	P. male	SF	AM	L Parietal	High
SK 4063	Kew	B	>18	P. female	BF	PM	R Parietal	Mid
GEN0154	Mortlake	C	46+	Male	BF	AM	R Parietal	High
SK 4079	Mortlake	C	>18	P. male	BF	AM	L Parietal	High
SK 4071	Mortlake	C	46+	P. male	BF	PM	R Parietal	Mid
SK 4078	Mortlake	C	>18	P. female	BF	AM	R Parietal	High
SK 4096	Mortlake	C	>18	Undet’	SF	PM	L Parietal	Mid
SK 4086	Mortlake	C	46+	Indet'	BF	PM	R Parietal	Mid
SK 4104	Mortlake	C	>18	P. male	BF	PM	LP	High
SK 1508	Chiswick Reach	C	>18	P. male	BF	AM	R Parietal	High
					BF	AM	Frontal	High
					BF	PM	Frontal	Mid
					BF	PM	Frontal	Mid
GEN0158	H’Smith Bridge	C	46+	P. male	TREP	AM	RP	High
					SF	AM	R Parietal	High
SK 4123	Wandsworth	D	26-45	P. male	BF	PM	R Parietal	High

SK ID	Location	Zone	Age-at-death (years)	Sex	Lesion type	Lesion timing	Affected bone	Probability
SK 4124	Wandsworth	D	>18	Indet'	SF	PM	L Parietal	Mid
GEN0180	Wandsworth	D	26-45	Indet'	SF	PM	Frontal	High
					SF	PM	R Temporal	High
GEN0155	Barn Elms	D	18-25	Male	SF	PM	Mandible	High
					SF	PM	Mandible	High
					SF	PM	Mandible	High
					SF	PM	Mandible	High
					SF	PM	Mandible	High
					SF	PM	Mandible	High
FWW03	Putney	D	Subadult <18	NA-Subadult	BF	PM	R Parietal	High
SK 1517	Battersea Bridge	E	26-45	Indet'	BF	PM	L Parietal	High
SK 4138	Chelsea	E	26-45	P. female	SF	PM	L Parietal	Mid
SK 4136	Westminster	F	46+	P. male	SF	AM	Frontal	High
					SF	AM	R Parietal	High
					SF	AM	R Parietal	High
SK 1525	North Dock	G	>18	P. male	BF	PM	R Parietal	High
					SF	PM	L Parietal	Mid
SK 1441	Thames	T	Subadult <18	NA-Subadult	SF	PM	R Parietal	High
SK 1442	Thames	T	26-45	P. male	SF	PM	R Temporal	High
SK 1464	Thames	T	>18	P. male	BF	AM	Frontal	High
SK 1467	Thames	T	26-45	Indet'	SF	AM	R Parietal	High
					SF	AM	R Parietal	High
SK 1477	Thames	T	>18	Indet'	BF	PM	Occipital	Mid
SK 1480	Thames	T	26-45	Male	BF	AM	L Parietal	High
SK 1481	Thames	T	26-45	P. male	BF	AM	L Parietal	High
SK 1484	Thames	T	26-45	Male	BF	AM	Frontal	High

SK ID	Location	Zone	Age-at-death (years)	Sex	Lesion type	Lesion timing	Affected bone	Probability
SK 1486	Thames	T	46+	P. male	BF	PM	Frontal	High
					BF	PM	L Parietal	High
					BF	PM	R Parietal	High
SK 1490	Thames	T	>18	Male	BF	PM	Frontal	High
SK 1494	Thames	T	46+	Male	BF	AM	L Parietal	High
					BF	AM	R Parietal	High
SK 1497	Thames	T	26-45	Indet'	BF	PM	Frontal	High
SK 1527	Thames	T	26-45	P. male	BF	AM	Frontal	High

Table 7.10: The 33 trauma-affected individuals in the River Thames assemblage which do not currently have radiocarbon dates, alongside associated contextual information and information on the nature of the injuries. All sex estimations are osteologically-determined ('"Indet" refers to individuals of indeterminate osteological sex). In the "Lesion type" column "BF"= blunt force, "SF"= sharp force, "TREP"= trepanation. In the "Lesion timing" column "AM"= antemortem, "PM"= perimortem. The letter given in the "Zone" column refers to the section of the river from which the individual was recovered, as described in Section 4.1.1.2.4.

GEN01 55, Barn Elms

Mandible GEN01 55, an adult male recovered from the Barn Elms stretch of the river presented a combination of perimortem injuries highly consistent with decapitation (Figure 7.17, cf. Kimmerle and Baraybar, 2008:315-319). The presence of these injuries had not previously been identified. The right ascending ramus presented a single perimortem sharp force injury to the posterior aspect, which resulted in the complete removal of the gonial angle. The posterior margin of the left ascending ramus presented a series of five parallel perimortem cut marks, all of which were orientated medial-laterally across the long axis of the bone. This injury patterning is suggestive of decapitation which took place from behind; the injury to the right ramus likely reflects a single blow from a heavy bladed weapon, while the series of smaller cut marks on the left ramus could reflect a subsequent attempt to completely sever the head from the body.

Figure 7.17: A series of perimortem sharp force injuries indicative of decapitation on the posterior aspect of the mandible of GEN01 55, an undated male recovered from Barn Elms. © Museum of London.

GEN01 80, Wandsworth

GEN01 80, a cranium of indeterminate sex from Wandsworth, presented a large penetrating perimortem sharp force injury to their right anterior frontal bone, with accompanying fracture lines, and a small fan-shaped perimortem injury on their right mastoid process (Figure 7.18). The location of this second lesion on the mastoid process raises the question of whether this was an attempt to remove the ear (e.g., Western and Hurst, 2013; Geber, 2015). It has also been suggested that perimortem sharp force injuries to the mastoid process could represent an attempt to remove the head, as the sternocleidomastoideus muscle extends from the mastoid process to the sternum and clavicle, and stabilises the head (Redfern, 2008). The fan-shaped morphology implies the application of a sideways slicing/twisting motion (Bergerbrant et al., 2013) which may only have been possible to achieve if the victim was immobile when the wound was inflicted, e.g., unconscious, restrained, or dead.

Figure 7.18: Two perimortem sharp force injuries on GEN01 80, an undated cranium of indeterminate sex recovered from Wandsworth. © Museum of London.

GEN01 58, Hammersmith Bridge

An adult, probable male, calvarium recovered from the Hammersmith Bridge area presented a large healed trepanation on the superior aspect of their cranium (Figure 7.19, 1). The lesion was positioned on the right parietal bone near the sagittal suture, which it crosses at its posterior extent, and was orientated in a broadly anterior-posterior direction. The morphology of the lesion (e.g., oval shape, broad external bevel) suggests that the trepanation was performed using a scraping technique. The extensive remodelling of bone around the lesion indicates its antemortem status. Widespread remodelled lamellar bone was also present across the cranial vault and potentially indicates a past period of infection, which could have been associated with the healing process. The calvarium also presented a large antemortem sharp force lesion on the right parietal (Figure 7.19, 2) which is close to, and roughly parallel with, the trepanation aperture.

Figure 7.19: Antemortem trepanation (1) and antemortem sharp force injury (2) on the right parietal bone of GEN01 58, an undated probable male calvarium recovered near Hammersmith Bridge. Anterior is towards the top of the image, posterior towards the bottom. © Museum of London.

SK 4136, Westminster

SK 4136, an adult probable male cranium recovered near Westminster Bridge, is notable for the presentation of three antemortem sharp force injuries (Figure 7.20): 1) a linear incision on the right frontal bone which arises on the temporal line and extends almost vertically downwards to the eye orbit; 2) a kidney-shaped lesion on the posterior right parietal, the morphology of which indicates a blade struck the bone at a shallow angle, removing the cortical bone; and 3) another smaller lesion with a similar morphology to 2 on the superior right parietal bone. However, only the cortical bone has been affected in lesion 3. These lesions presented minimal bone remodelling, indicating that the individual survived for only a short while after they were inflicted. For example, the edges of the lesion were still very clearly defined and relatively smooth in lesion 2. These lesions were all identified for the first time in this study.

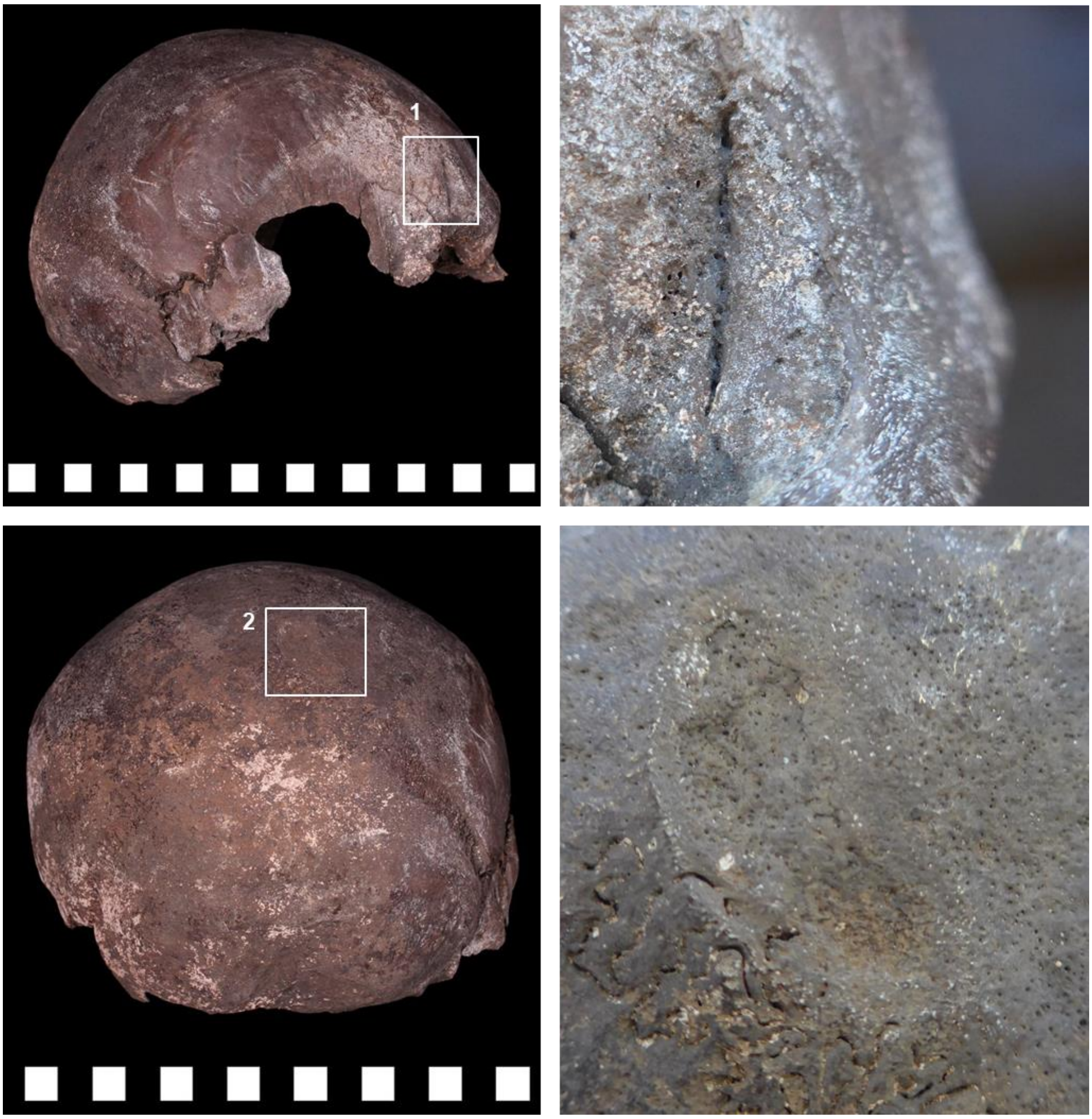

Figure 7.20: Two of the three antemortem sharp force injuries on SK 4136, an undated probable male calvarium recovered from Westminster. © The Trustees of the Natural History Museum, London.

7.7 Violence-related trauma: River Thames assemblage discussion

7.7.1 Overview

A high prevalence of violence-related trauma was identified in the River Thames assemblage, with a crude prevalence of 22.9% (51/223 individuals affected). This is a higher prevalence than previously identified by Schulting and Bradley (2013) of 14.0% (21/150 crania affected). The higher prevalence in this study has arisen partially through a larger sample size, but also as a result of the identification of many new cases of trauma on previously-examined individuals (e.g., SK 1514, SK 4136, GEN01 55). No previous record existed for 73.5% (61/83) of the lesions presented in this study.

Currently, there are radiocarbon dates for 18 of the trauma-affected individuals, and seven of these have been provided for the first time in this study. These dated individuals cover almost all time periods, from the Bronze Age to the Post-Medieval Period. No examples of violent trauma have so far been identified in individuals of Neolithic date, though only four were part of the osteological dataset.

The majority of dated individuals belong to the Iron Age (9 individuals), and this period also had the highest overall prevalence of trauma for any time period at 64.3% (9/14 individuals affected). The individuals dated so far mainly belong to the Early Iron Age (four individuals), and the Middle Iron Age (four individuals).

The Bronze Age had a lower crude prevalence of trauma than the subsequent Iron Age at 26.7% (4/15 individuals affected), with a similar number of individuals available for examination. One individual was of Early Bronze Age date, one was Middle Bronze Age and two were Late Bronze Age. The presence of trauma on the two Late Bronze Age individuals (UNREG 1414 and SK 4073, both of which were dated for the first time in this study) is particularly interesting to note in relation to the general scarcity of direct, skeletal evidence for violence in this time period (see Section 7.9.2 for detailed discussion).

A large number of affected individuals (33) remain undated at present, so the extent to which the current temporal patterns are representative of the overall pattern for the trauma-affected portion of the assemblage is unknown. However, based on the geographic distribution of the undated individuals, many are perhaps likely to be Iron Age or Late Bronze Age in date (see Section 6.2 for the reasoning behind this). Nine

undated trauma-affected individuals were from zone C (Mortlake-Hammersmith), five from zone D (Putney-Wandsworth), and 13 belonged to the general “Thames” group. There is also no reason to suppose that further radiocarbon dating of the undated trauma-affected individuals would greatly change the current temporal distribution of affected individuals.

7.7.2 Interpreting the patterns of trauma

A strong relationship has been identified between human remains recovered from watery environments and violence (e.g., see Section 2.2.1.3). These indications of past violence have been interpreted in a number of different ways: some as the remnants of past battles (e.g., Jantzen et al., 2011; Brinker et al., 2013; Mollerup et al., 2016), some as ritualised or performative violence at the point of death, which has been a particularly strong theme in the interpretation of the perimortem injuries often identified in bog bodies (Chapman and Gearey, 2019).

Interpreting the circumstances in which violent skeletal trauma occurred is notoriously difficult in bioarchaeological studies, and relies strongly on the accompanying contextual information (e.g., circumstances of burial, secure dating). In general, as the contextual evidence increases the number of possible explanations for the trauma should decrease (Anderson, 2014). As many of the trauma-affected Thames individuals are lacking in contextual information (e.g., incomplete remains, no radiocarbon date), interpretations of the nature of the violence experienced are somewhat limited. However, the patterning of the injuries themselves can go some way to suggesting the nature of violence experienced (e.g., Schulting and Fibiger, 2012; Fibiger et al., 2013; Knüsel and Smith, 2014; Gowland, 2016; Walker, 2016).

7.7.2.1 Inter-group violence?

The high prevalence of trauma in the Thames assemblage is perhaps best contextualised in relation to British Iron Age sites, owing to the large number of Iron Age, and suspected Iron Age individuals. The trauma prevalence in the overall assemblage (22.9%) and known Iron Age portion (64.3%) is much higher than the generally low prevalence of antemortem and perimortem trauma observed for the general Iron Age burial population. For example, a review of Late Bronze and Iron Age human remains from 100 central and southern British sites by Roth (2016) identified a trauma prevalence of 0.06%. No examples of perimortem trauma were identified at the

Late Iron Age attritional cemetery of Mill Hill in Kent (Anderson, 1997). The prevalence of trauma identified in the River Thames assemblage is therefore greater than that which would be expected in general attritional cemetery populations.

The majority of individuals affected by violent trauma in the River Thames assemblage were adult males who sustained cranial injuries. The majority of injuries were sharp force and blunt force, which implies a high level of hand-to-hand combat (Dittmar et al., 2019). The concentration of trauma on the frontal bone and parietal bones further indicates a high level of face-to-face combat (Jantzen et al., 2011; Schulting and Fibiger, 2012; Fibiger et al., 2013; Cohen et al., 2014). The high prevelance of perimortem injuries, with 47 separate lesions and 30 individuals affected, indicates that many individuals could have suffered a violent death.

The individuals directly dated to the Iron Age particularly conform to this profile. Seven of the nine affected individuals were adult males (five of these genetically identified), with the others being an osteologically-identified probable female and an adolescent. Six individuals were affected by perimortem trauma. For five of these individuals the perimortem lesions penetrated the cranial vault and could have been fatal. The morphology of the perimortem injuries on two individuals of Iron Age date, SK 1520 and SK 1529, are highly consistent with one another, and could have potentially been produced by spears. Spears were the combat weapon of choice in the Iron Age (Wells, 2020) and, interestingly, are also the best represented weapon class among the Bronze Age and Iron Age metalwork recovered from the Thames (Ehrenberg, 1980; Needham and Burgess, 1980; Fitzpatrick, 1984; York, 2002).

The Early Iron Age individual SK 1506 from Mortlake, dated for the first time in this study, provides another example of a patterned weapon injury: the morphology of their antemortem sharp force injury indicates the use of a sword, having one very straight and one slightly curved edge (Lewis, 2008). The existence of a probable sword injury of this date is of particular note: swords are a weapon class associated with elite individuals in Early Iron Age Europe (Wells, 2020). For example, across Europe they are present only in the most richly furnished graves. They are often considered to have had a particularly symbolic role, but the presence of such an injury provides direct evidence for their use to perpetrate violence.

High prevalence of trauma, accompanied by demographic and injury patterning such as this are often associated with groups engaged in episodes of intergroup conflict at

various scales, such as warfare or raiding (Lambert, 2002; Kjellström, 2005; Redfern and Chamberlain, 2011; Flohr et al., 2014; Dittmar et al., 2019). For example, similar prevalence and patterning of trauma has been identified in the human remains associated with various Iron Age hillfort sites including Maiden Castle (Redfern, 2011), Danebury (Craig et al., 2005), and Kemerton Camp (Western and Hurst, 2013). At Maiden Castle, the overall prevalence of trauma was 74.2%, males were disproportionately affected, and high levels of both antemortem and perimortem trauma to the head were observed. It was argued by Redfern (2011) that this patterning likely reflected multiple episodes of inter-or intra-community warfare.

At present there is no strong indication that the remains belong to any single episodes of violence, contra to the situation for some watery sites where similarly high prevalences of violent trauma have been identified (Jantzen et al., 2011; Brinker et al., 2013; Mollerup et al., 2016). However, three individuals with perimortem injuries have similar Early Iron Age dates (SKs 1520, 1529, 4069). Interestingly, two of these (SK 1520, Figure 7.10, and SK 1529, Figure 7.11) also have very similar injury patterning.

7.7.2.2 Ritual violence?

Although difficult to identify, and highly context-specific, there is limited obvious evidence in the overall assemblage for forms of ritualised or performative violence. Injury patterns indicating decapitation, mutilation, and overkill are often associated with these forms of violence (Chapman and Gearey, 2019; Armit, 2020; Redfern, 2020). For example, Lindow II, a first century AD bog body from Cheshire, presented two wounds to the crown of the head, probably administered while he was kneeling, soft tissue injuries which suggested his throat had been cut, and a rib fracture indicative of a blow to the back (Chapman and Gearey, 2019). Such forms of violence may be more difficult to identify in the River Thames individuals however, as they are represented by cranial remains only, with no soft tissues: e.g., in the case of Lindow II, the ritualised nature of the violence experienced would not be identifiable as such if only the skeletonised cranium was present.

7.7.2.2.1 Decapitation

One compelling example of decapitation was identified in the assemblage, through a series of newly-identified lesions on an undated male mandible (GEN01 55), recovered from the Barn Elms area (Figure 7.17). Decapitation can reflect various practices

including corporal punishment, mortuary practices, head hunting, or armed confrontation where the neck is a target (Boylston et al., 2000; Craig et al., 2005; Armit, 2020). It is not possible to speculate far about the circumstances of decapitation in the case of GEN01 55, particularly given the current lack of radiocarbon date. However, the location and morphology of the large lesion on the right ramus indicates this substantial blow was delivered from the back/back right side, possibly while the individual was kneeling, and is highly consistent with the patterning of mandibular injuries observed in execution victims in forensic cases (e.g., see Choeng Ek case study in Kimmerle and Baraybar, 2008:315-319). The accompanying series of fine parallel cut marks on the left ramus likely represent an attempt to completely remove the head, possibly subsequent to the larger blow and with a finer bladed instrument. Overall, the patterning of injuries suggests that the initial blow was involved in the death of the individual, possibly in an execution-style killing, and that this was followed by the complete removal of the head potentially for display or curation.

7.7.2.2.2 Mutilation

Further possible examples of bodily mutilation were observed on two crania: one undated individual of indeterminate sex from Wandsworth (GEN01 80; Figure 7.18) and one male of Late Iron Age date from Waterloo (SK 1558; Figure 7.15). The perimortem sharp force injury to the mastoid process of GEN01 80 could have related to the removal of the ear or the head, while the positioning of the two perimortem cut marks on the site of the temporalis muscle attachment of SK 1558 probably relates to removal of the ear (Redfern, 2008; Western and Hurst, 2013; Geber, 2015). These lesions could have arisen in various contexts; however their morphology suggests that the individuals were immobile when the wounds were sustained, so it is perhaps unlikely they were inflicted during face-to-face attacks prior to death. Of particular relevance to SK 1558, radiocarbon dated 50 cal BC to cal AD 65, similar cut marks have been identified on cranial remains of Iron Age date elsewhere in Britain, and have been interpreted as dismemberment relating to secondary burial practices (Redfern, 2008) and mutilation and exhibition of the dead, particularly of individuals who had experienced a violent death (Craig et al., 2005; Western and Hurst, 2013).

7.7.2.3 Trepanation

Two instances of antemortem trepanation were present in the River Thames assemblage, both of which had been identified previously (Parry, 1921; Edwards et al.,

2009; Schulting and Bradley, 2013). GEN01 59 from Chelsea (Figure 7.7), only recovered from the foreshore in 2001, has been radiocarbon dated to the later part of the Early Bronze Age while GEN01 58 (Figure 7.19), dredged near Hammersmith Bridge in 1864, remains undated. Writing about the Hammersmith calvarium a century ago, Parry (1921) suggested a prehistoric date was likely, noting that "pile dwellings of Early Iron Age date" had been found on the riverbank close to where the cranium was recovered, but had since been dredged away. Both individuals were osteologically identified as males and both lesions had been performed using a scraping technique, which has also been identified in other examples of prehistoric trepanation from Britain (Roberts and McKinley, 2003). The extensive remodelling of the lesion margins indicates the long-term survival of both individuals (i.e., for at least more than several weeks) (Verano, 2003).

Trepanations can be performed for a variety of purposes, from therapeutic attempts to treat head injuries or health conditions such as headache or epilepsy, to magico-ritual purposes (Zimmerman et al., 1981; Verano, 2003). The motivations for the trepanation on the Early Bronze Age GEN01 59 are unclear, however the trepanation on GEN01 58 likely relates to the treatment of cranial trauma, as a substantial antemortem sharp force lesion was located close to the trepanation aperture on the right parietal (Figure 7.19). Trepanation could have been performed following a head injury in order to drain epidural hematomas (Verano, 2003).

Trepanations are rare from prehistoric British contexts: only 20 other prehistoric cases of trepanation are currently known, with six of these being Bronze Age in date (Roberts and McKinley, 2003). The Chelsea individual is notable for being the only Bronze Age example recovered from a non-grave context, with the other examples recovered from barrows, cists, or cemeteries. Only one other prehistoric (though undated) example is known from a riverine context, though the classification of this as a trepanation is tentative as it may actually represent a postmortem modification (Parry, 1921). Only eight of the 62 British trepanations reviewed by Roberts and McKinley (2003) presented concurrent examples of cranial trauma, and none of these dated to the prehistoric period. However, prehistoric examples of trepanation associated with cranial trauma are known from elsewhere in Europe (e.g., Moghaddam et al., 2015; Khudaverdyan, 2016; Giuffra and Fornaciari, 2017). The GEN01 58 calvarium either represents the only prehistoric British example of trepanation as a treatment for cranial injury, or the presence of the healed injury is an indication it may be later in date.

The observed trepanations raise questions as to the social identity of these individuals and the communities from which they came (Roberts and McKinley, 2003; Moghaddam et al., 2015). The two Thames examples fit with a generally observed pattern of the majority of British examples being located in South East England, possibly reflecting proximity to the Continent where trepanation appears to have been more commonly practiced (Roberts and McKinley, 2003).

The question of whether these trepanned individuals represented “special” individuals within their communities is open to debate. The general rarity of trepanations in prehistory may suggest a link with elevated social identity. However, Roberts and McKinley (2003) conclude their review of British trepanations by stating the available evidence doesn’t particularly indicate special status of trepanned individuals, as far as can be accessed through their burial treatment. A review of all known cases of trepanation in Italy reached a similar conclusion (Giuffra and Fornaciari, 2017).

7.7.3 Over-estimation? Taphonomic considerations relevant to watery environments

It is important to consider whether the high prevalence of trauma identified in the River Thames assemblage may, to an extent, be related to their deposition in a watery environment. As described in Section 4.5.2.4, the interval during which bone responds to damage in a characteristically ‘perimortem’ manner may be prolonged in watery environments, as moisture and the organic collagen component are retained (Galloway et al., 1999; Kjellström and Hamilton, 2014). This could potentially lead to postmortem taphonomic damage being erroneously identified as perimortem trauma.

In particular, the taphonomic damage sustained during fluvial transport of the remains, or exposure to a fluvial environment (e.g., river debris striking the head), could mimic cases of perimortem trauma (e.g., Brooks and Brooks, 1996). The general levels of abrasion observed in the River Thames assemblage and the loss of facial bones (Section 6.3.1) means this cannot be completely ruled out as a possibility in some of the identified cases of perimortem trauma. However, such damage is probably most likely to mimic perimortem blunt force trauma, rather than sharp force or projectile trauma. As such, fluvial damage may only be a consideration for some of the 18 identified cases of perimortem blunt force trauma, which only comprise 21.7% of the overall lesions.

Taphonomic damage sustained during dredging is also potentially a relevant factor to consider in relation to the identified cases of perimortem trauma. On the basis of the recovery dates of the dredged remains, they are most likely to have been recovered via steam dredging, where material from the riverbed was removed by metal buckets attached to a steam-powered conveyor belt (Skempton, 1974). Such a process would certainly have had the potential to damage the cranial remains; however, fairly uniform patterns of damage may be expected, and none were observed. Furthermore, being more recent in origin, the surfaces of the broken areas would not be likely to have a consistent taphonomic patina with the surrounding areas of bone, and would therefore have been classified as postmortem damage (see Section 4.5.2.3). Taphonomic damage sustained during dredging can be more or less ruled out as a causative factor in the perimortem trauma observed in the River Thames assemblage.

Overall, these taphonomic factors are unlikely to have greatly affected the prevalence and patterns of trauma identified in the River Thames assemblage. The patterns of antemortem trauma will be completely unaffected and, in terms of perimortem trauma, it is only potentially some of the blunt force injuries which could have arisen through exposure to a fluvial environment, and these only constitute a relatively small proportion of the overall lesions.

7.7.4 Summary of violence-related trauma in the River Thames assemblage

A high prevalence of violence-related trauma has been identified in the River Thames assemblage: individuals who had experienced violence account for nearly a quarter of the overall skeletal assemblage. Taphonomic factors are not likely to have greatly influenced the observed patterns of trauma, and the prevalence of violence identified through the skeletal lesions may actually underrepresent the actual level of violence experienced by these individuals, as much violence only affects soft tissues.

Many of the trauma-affected individuals were males who appear to have been engaged in face-to-face violence with lethal intent. The presence of both antemortem and perimortem injuries suggests the presence of individuals who experienced episodes of violence during life and also, for some, at around the time of their death. Only a few examples of more ritualised forms of violence were observed in the assemblage, but this is difficult to identify, particularly given the incomplete nature of the Thames individuals (e.g., majority represented by crania only) and the lack of supporting context.

The current temporal patterning suggests that the majority of all trauma-affected individuals could be of Iron Age date, and potentially also Late Bronze Age, though further radiocarbon dating of the undated trauma-affected individuals is needed to confirm this pattern. Further radiocarbon dating of the individuals with potential evidence of ritualised violence would also advance current interpretations: e.g., if Iron Age in date, they could potentially be linked to wider practices of mutilation and display of the dead (e.g., Craig et al., 2005; Western and Hurst, 2013).

The observed trauma patterning has various implications for interpreting the deposition of the Thames assemblage, which will be expanded on in the main discussion chapter. For example, there appears to be a possible relationship between forms of intergroup violence and deposition, potentially particularly during the Iron Age. The findings also strengthen the argument for more of a direct link between the Thames human remains and the items of weaponry recovered from the river, many of which show evidence of use (Fitzpatrick, 1984; York, 2002).

7.8 Violence-related trauma: Maynard Reservoir assemblage results

Three separate elements in the Maynard Reservoir assemblage, two crania and one humerus, presented single perimortem injuries (Table 7.11). This gave the assemblage an overall crude trauma prevalence of 9.1% (3/33 elements affected). When only the complete crania were considered (excluding single cranial bones), the crude trauma prevalence rises to 28.6% (2/7 crania affected).

Three different individuals were represented by the affected elements: the two crania belonged to adult individuals, one female (SK 4191) and one of indeterminate sex (SK 3311), and the humerus to an adolescent individual aged 11-17 years on the basis of epiphyseal fusion (SK 4200A). The sex of the female cranium is a genetic determination.

SK ID	**Date**	**Element**	**Age-at-death (years)**	**Sex**	**Lesion timing**	**Lesion type**
SK 4191	1220-1055 cal BC	Cranium	26-45	Female*	Perimortem	Blunt force
SK 3311	1110-900 cal BC	Cranium	26-45	Undetermined	Perimortem	Blunt force
SK 4200A	Undated	R humerus	11-17	NA- subadult	Perimortem	Sharp force

Table 7.11: The three trauma-affected individuals in the Maynard Reservoir assemblage, alongside associated contextual information and information on the nature of the injuries. An asterisk in the “Sex” column indicates a genetic sex determination, those without are osteologically-determined.

The two crania, both of which are Late Bronze Age in date, presented perimortem blunt force injuries. The female cranium, SK 4191, presented a large blunt force injury on the right side of their cranium, which resulted in the loss of a large area of bone and produced secondary concentric and radiating fractures (Figure 7.21). The primary area of impact appears to have been the right superior frontal bone. SK 3311 presented an elliptical depressed fracture to the superior part of the left frontal bone (Figure 7.22).

SK 4200A, the right humerus belonging to an adolescent individual, presented a perimortem sharp force injury on the lateral border of the distal diaphysis (Figure 7.23). This is a small cut mark, orientated in an anterior-posterior direction.

Figure 7.21: Superior view of a perimortem blunt force injury on the right frontal bone and parietal bone of SK 4191, a Late Bronze Age (1220-1055 cal BC) female cranium recovered from the Maynard Reservoir. © The Trustees of the Natural History Museum, London.

Figure 7.22: Superior view of a perimortem sharp force injury on the left frontal bone of SK 3311, a Late Bronze Age (1110-900 cal BC) cranium of intermediate sex recovered from the Maynard Reservoir. © The Trustees of the Natural History Museum, London.

Figure 7.23: Posterior view of the perimortem sharp force injury on the lateral margin of the right distal humerus of SK 4200A, an undated adolescent aged 11-17 years, recovered from the Maynard Reservoir.

7.9 Violence-related trauma: Maynard Reservoir assemblage discussion

7.9.1 The injuries

The Maynard Reservoir assemblage presented evidence for perimortem trauma involving three individuals, represented by two adult crania of Late Bronze Age date and one subadult humerus. The injuries on the crania had previously been reported (Schulting and Bradley, 2013); the humeral injury is newly-identified here. It is unclear whether the injuries are likely to have been sustained in the same, or separate, episodes. The crania are dated to 1220-1055 cal BC (SK 4191) and 1110-900 cal BC (SK 3311) and therefore do overlap in date, but only for 55 years between 1055 and 1110 cal BC. The humerus is undated.

The position and patterning of these injuries suggests that they were likely sustained in violent face-to-face encounters at close quarters and were not, for example, of accidental origin or related to mortuary practices.

The two affected crania each presented a single perimortem blunt force injury. Both injuries were located on the frontal bone, suggesting they were sustained in face-on attacks, but were morphologically distinctive. For the female individual, SK 4191, a blunt impact with significant force would have been necessary to produce the observed degree of secondary fracturing (Kimmerle and Baraybar 2008:159). The morphology of the lesion on SK 3311 (e.g., an elliptical depressed fracture with irregular margins) is consistent with having been produced by a blunt-edged, linear object. No directly analogous injuries are currently published from Late Bronze Age British contexts. Candidate weapons could possibly include stone mace heads, which were still in use in Bronze Age Europe at this time (Thorpe, 2013).

In relation to these blunt force injuries it is interesting to note that four “clubs” were recovered in close proximity to the human remains at the “cranoge” site (see Figure 5.8, numbers 25 and 26). Direct evidence of wooden clubs being used as weapons in Late Bronze Age Europe has been revealed in the Tollense River Valley in Germany, where a variety of wooden weapons were recovered alongside skeletal remains with blunt force injuries (Jantzen et al., 2011). Such implements would have certainly been capable of producing the injury on SK 4191 and potentially also SK 3311, depending on their shape.

The adolescent humerus, SK 4200A, presented a single, perimortem sharp force injury on the lateral border of the distal diaphysis. Sharp force injuries at the elbow joint are sometimes associated with dismemberment; however, in such cases multiple lesions are often present (Kimmerle and Baraybar, 2008). Similar lesions may also be expected to have been observed elsewhere in the assemblage, if dismemberment was related to mortuary practice. Instead, the position and patterning of the lesion could reflect a defensive injury, which the individual may have sustained while using their arm to ward off an attack (e.g., Rautman and Fenton, 2005; Dittmar et al., 2019).

7.9.2 The Maynard Reservoir trauma in Late Bronze Age context

The trauma within the Maynard Reservoir assemblage is of considerable archaeological significance. Direct evidence of violence in Late Bronze Age British

skeletal remains is rare, with only a handful of other cases currently identified (Osgood, 2006; Leach, 2015; McKinley, 2017). This scarcity probably reflects the lack of a visible burial practices in this period (McKinley, 2017). The newly-identified and dated River Thames crania aside (SK 4073 and UNREG 1414), there is only one other isolated example of Late Bronze Age skeletal trauma from a watery context in Britain. A male cranium associated with cut-marked vertebrae, dated 1040-810 cal BC, was recovered from palaeochannels of the River Soar in Leicestershire (Ripper et al., 2012). The patterning of the injuries suggested the individual had their throat cut in a face-to-face encounter, before having two further cuts inflicted to the back of their neck (Ripper et al., 2012:194).

Elsewhere in Britain, there is some skeletal evidence for violence which may relate to episodes of small scale conflict, after which bodies have been denied normal burial rights. At Tormarton in Gloucestershire, a group of five young adult males were recovered from a ditch (Osgood, 2006). Two of these individuals had perimortem spear injuries: one had been speared twice in the pelvis and the other stabbed multiple times with a spear, the head of which was still embedded in the bone.

Another Late Bronze Age example of skeletal trauma appears to point to the existence of more ritualised forms of violence. At the site of Cliffs End Farm in Kent, an older adult female skeleton presented multiple perimortem sharp force injuries to the back of their head, probably caused by a sword (McKinley, 2017). The circumstances of their burial were unusual; she was buried with two neonatal lambs on her lap and holding a piece of chalk up to her face in one hand, while the other pointed towards a central enclosure. She was located at the centre of a group of burials, which included children whose skulls had been manipulated after at least partial decomposition, and an adolescent whose upper body lay over the face and neck of a cow. It was suggested by McKinley (2017) that she may have been involved in an episode of ritualised violence, perhaps as a willing sacrifice.

What, exactly, may have been the circumstances in which the Maynard Reservoir assemblage trauma were obtained will be considered further in the main discussion chapter, along with complimentary lines of supporting evidence (e.g., taphonomy, the demographic profile). However, to summarise for now the Maynard Reservoir assemblage presents rare evidence of Late Bronze Age skeletal trauma, and for the involvement of at least three individuals, including one female and an adolescent individual, in violent face-to-face encounters at around the time of their deaths.

Chapter 8 Perspectives on diet from carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulphur ($\delta^{34}S$) stable isotope analysis

This chapter addresses Aim E: to investigate the dietary compositions of individuals within the assemblages, through the application of carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$), and sulphur ($\delta^{34}S$) stable isotope analysis. The results are presented in Section 8.1, a discussion of the results is given in Section 8.2, and a summary of the findings is presented in Section 8.3.

8.1 Results

In this section, an overview of the faunal baseline $\delta^{13}C$ and $\delta^{15}N$ dataset is given (Section 8.1.1), followed by an overview of the $\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ values for the human remains (Section 8.1.2).

8.1.1 Faunal baseline data

Baseline $\delta^{13}C$ and $\delta^{15}N$ data were gathered for cattle, ovicaprids, and pigs belonging to each of the relevant time periods, from nine Thames Valley sites (outlined in Table 4.7). An overview of the faunal baseline data is given in Table 8.1, and the mean values for each species within each time period are plotted in Figure 8.1 alongside the human values.

The $\delta^{13}C$ and $\delta^{15}N$ values for all fauna and time periods were consistent with those expected for animals primarily consuming terrestrial C_3 resources.

In each time period, the mean $\delta^{13}C$ value of pigs is higher than those of cattle and ovicaprids, and they have a correspondingly higher overall mean value of -20.8‰, compared to -21.9‰ for cattle and -22.0‰ for ovicaprids (Table 8.1). The mean $\delta^{15}N$ values for ovicaprids and pigs are consistently higher than those of cattle for each time period, and they also have correspondingly higher overall mean values of 7.2‰ and 7.0‰ respectively, compared to 6.3‰ for cattle (Table 8.1). Higher $\delta^{15}N$ values in ovicaprids compared to cattle could reflect the fact that they were being raised on more intensively manured pasture (e.g., Madgwick et al., 2012:134), while higher $\delta^{15}N$ and $\delta^{13}C$ values may be observed in pigs as a result of their omnivorous diets.

No linear temporal trends in either $\delta^{13}C$ or $\delta^{15}N$ are observable within any of the species, but statistically significant differences are present between time period values (indicated using paired symbols in Table 8.1). The Roman period presents relatively high $\delta^{15}N$ values for each species, which is reflected in several statistically significant differences between the $\delta^{15}N$ values of the Roman and other periods. The Iron Age also presents relatively high $\delta^{15}N$ values for pigs, with a mean value of 8.3‰, and statistically significant differences with other periods. The Neolithic period is notable for having particularly high pig $\delta^{13}C$ values compared to the other time periods, with a mean value of -20.3‰, reflected in statistically significant differences between the Neolithic and all other time periods apart from the Medieval period. A similar trend of higher $\delta^{13}C$ pig values in the Neolithic has been observed in other studies, and attributed to the use of wildwood resources (Hamilton and Hedges, 2011; Stevens et al., 2012).

Period	Cattle				
	n	δ^{13}C		δ^{15}N	
		mean	**σ**	**mean**	**σ**
Neolithic	52	-22.0†	0.6	6.0†	0.8
Bronze Age	37	-22.0	0.5	6.5	1.5
Iron Age	35	-21.8	0.4	6.3	1.3
Roman	46	-21.6†	0.4	6.7†	1.1
Medieval	4	-21.6	0.2	5.8	0.4
Post-Medieval	13	-21.9	0.2	5.8	1.6
All periods	**187**	**-21.9**	**0.5**	**6.3**	**1.2**
Period	**Ovicaprids**				
Neolithic	21	-21.6	0.5	6.5†	1.2
Bronze Age	35	-21.7	0.5	7.3	1.2
Iron Age	23	-21.9	0.4	7.2	1.1
Roman	53	-21.6	0.5	7.7†*	1.4
Medieval	2	-21.3	0.1	6.1	0.4
Post-Medieval	17	-21.9	0.3	6.3*	1.5
All periods	**151**	**-21.7**	**0.5**	**7.2**	**1.4**
Period	**Pigs**				
Neolithic	34	-20.3†*^°	0.5	6.6†	1.0
Bronze Age	22	-21.0†	0.4	6.3*^	1.5
Iron Age	12	-21.6*	0.3	8.3†*	1.4
Roman	15	-21.0^	0.6	8.0^	1.7
Medieval	1	-20.9	NA	6.0	NA
Post-Medieval	10	-21.2°	0.1	6.7	1.9
All periods	**94**	**-20.8**	**0.6**	**7.0**	**1.6**
Period	**All species**				
Neolithic	107	-21.3	0.9	6.4	0.3
Bronze Age	94	-21.6	0.5	6.7	0.5
Iron Age	70	-21.8	0.2	7.3	1.0
Roman	114	-21.4	0.3	7.5	0.6
Medieval	7	-21.3	0.4	6.0	0.2
Post-Medieval	40	-21.7	0.4	6.3	0.5

Table 8.1: Mean and standard deviation δ^{13}C and δ^{15}N values for the faunal baseline dataset, shown by species and time period. The presence of paired symbols (†*^°) between the isotope values of two time periods within each species indicates a statistically significant difference between the values. N.B., the mean values for all species within each time period are calculated as the mean of each species mean, to avoid issues arising from the uneven distribution of species.

8.1.2 The Human δ^{13}C, δ^{15}N, and δ^{34}S data

A summary of the isotope results is presented in Table 8.2 alongside relevant associated information for each individual (e.g., radiocarbon date, sex). The isotope data are presented in full in Appendix Table C.1. The overall mean and standard deviations isotope values for each of the time periods are presented in Table 8.3. The human δ^{13}C and δ^{15}N values are shown plotted alongside the faunal baseline values in Figure 8.1, and the δ^{34}S and δ^{13}C, and δ^{34}S and δ^{15}N, human values in Figure 8.2 and Figure 8.3, respectively.

SK ID	Recovery Location	Period	Cal BC/AD (95% confidence)		Age-at-Death (years)	Sex	δ^{13}C	δ^{15}N	δ^{34}S
SK 1515	Battersea Bridge	Neolithic	-3950	-3380	26-45	Male*	-20.9	10.3	-6.0
SK 19	Crossness	Neolithic	-3640	-3525	46+	Male*	-21.0	10.6	NA
SK 4162	Northfleet	Neolithic	-2860	-2575	26-45	Female*	-22.3	10.9	NA
SK 4167	Battersea	Bronze Age	-1395	-1220	26-45	Female*	-21.0	10.8	-10.8
SK 1521	Battersea/ Vauxhall Bridge	Bronze Age	-1390	-990	46+	Male*	-20.9	11.2	-2.3
SK 1522	Battersea	Bronze Age	-1280	-1120	26-45	Male*	-20.6	10.1	-7.4
SK 4105	Mortlake	Bronze Age	-1275	-1120	18-25	Indet’	-20.5	11.0	-7.3
SK 4191	Maynard Reservoir	Bronze Age	-1220	-1055	26-45	Indet’	-20.8	10.8	-4.0
SK 4062	Kew	Bronze Age	-1215	-1015	18-25	Female*	-21.1	10.5	5.0
UNREG 1414	Battersea	Bronze Age	-1200	-1010	46+	Male*	-20.9	10.7	-0.5
SK 4067	Kew	Bronze Age	-1195	-1005	26-45	Male*	-20.1	11.1	-14.5
SK 4070	Mortlake	Bronze Age	-1120	-790	26-45	Male*	-20.0	11.5	-2.6
SK 3311	Maynard Reservoir	Bronze Age	-1110	-900	26-45	Female*	-20.5	11.5	-12.8
SK 1507	Mortlake Reach	Bronze Age	-1015	-860	26-45	Male*	-19.7	10.3	4.1
SK 4084	Mortlake	Bronze Age	-980	-830	>18	P. Male	-20.4	12.4	-6.1
SK 4073	Mortlake	Bronze Age	-970	-825	>18	Male*	-20.0	11.3	0.6
SK 1520	Battersea Bridge	Iron Age	-770	-420	26-45	P. female	-20.5	10.7	5.2
SK 1529	Thames	Iron Age	-770	-420	12-17	NA	-20.5	11.6	0.8
SK 1516	Battersea	Iron Age	-755	-420	12-17	NA	-20.3	11.5	-6.5
SK 4069	Mortlake	Iron Age	-750	-400	26-45	P. male	-20.6	9.4	-3.7

SK 1506	Mortlake Reach	Iron Age	-730	-405	46+	Male*	-20.4	11.7	-9.9
SK 4092	Mortlake	Iron Age	-520	-390	26-45	P. female	-20.8	11.8	-7.2
SK 1514	Chelsea Bridge	Iron Age	-400	-230	26-45	Male*	-20.5	10.7	-4.8
SK 4074	Mortlake	Iron Age	-400	-200	46+	Male*	-20.6	10.5	-5.4
SK 4055	Kew	Iron Age	-150	55	18-25	P. female	-20.9	12.6	-16.2
SK 1526	Northfleet	Iron Age	-150	25	26-45	Indet'	-19.8	12.3	16.3
SK 1558	Waterloo	Iron Age	-50	65	26-45	Male*	-20.0	12.0	7.7
SK 4120	Wandsworth	Roman	-40	130	46+	Male*	-20.4	11.2	6.7
SK 4130	Robiamors Dock, Limehouse	Roman	20	205	>18	Female	-18.8	11.8	4.0
SK 1518	Battersea	Roman	65	210	>18	Male*	-19.8	9.4	14.2
SK 4137	Deptford	Roman	80	215	>18	Male	-19.2	13.4	6.1
UNREG 6828	Battersea	Medieval	600	880	46+	P. Male	-20.0	11.9	5.6
SK 1551	Whitehall Steps	Medieval	665	775	18-25	Male*	-20.0	9.0	-1.9
SK 139	Millbank	Medieval	890	995	18-25	Male*	-19.7	9.1	11.3
E 213	Hampton	Medieval	1040	1210	>18	Male*	-20.2	13.0	-3.9
SK 4179	Waterloo Bridge	Medieval	1440	1615	26-45	P. Male	-19.0	13.2	4.0
SK 4119	Pimlico	Medieval	1520	1665	18-25	P. Male	-20.2	11.2	7.1
SK 4178	Greenwich	Post-Medieval	1530	1800	18-25	Male*	-19.8	11.4	6.1
SK 1523	Somerset House	Post-Medieval	1530	1800	>18	Female*	-19.1	13.0	5.6
SK 1524	Tower	Post-Medieval	1635	1800	>18	Indet'	-19.3	13.0	3.9
SK 1549	Poplar	Post-Medieval	1635	1800	26-45	Male*	-18.2	13.7	11.7
SK 1563A	Blackwall Tunnel	Post-Medieval	1665	1910	18-25	Female*	-19.3	12.0	6.7

Table 8.2: Summary of the $\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ values for each individual (SK ID), alongside information about their respective recovery location, radiocarbon date, time period, age-at-death category, and sex (N.B., '(*)' indicates genetic sex determination, those without are osteologically-determined. 'Indet' refers to individuals of indeterminate osteological sex). See Chapter 6 for determination of radiocarbon dates, and Chapter 7 for age-at-death and sex estimates.

8.1.2.1 Demography of the Thames remains isotopic dataset

Forty-two individuals met the criteria for inclusion in the stable isotope analysis (Table 8.2, and see Section 4.6.2). The temporal distribution of the isotopic sample is broad, ranging from the Neolithic to Post-Medieval periods, with the largest groupings in the Bronze Age (n=13) and Iron Age (n=11). Of the Bronze Age individuals, 12 out of 13 date to the Late Bronze Age. Genetic sex estimations are available for 14 of the Bronze and Iron Age individuals: 11 males and 3 females were identified, reflecting the overall male bias present in the wider assemblage (see Chapter 7).

In terms of their recovery location, the individuals cover a wide geographic range from Hampton in the west to Northfleet in the Thames Estuary. In-keeping with the pattern observed in the broader radiocarbon dataset (Chapter 6, Section 6.2), the majority of the Bronze and Iron Age individuals (19/24) were recovered from the western reaches of the Thames, specifically the relatively short stretch between Kew and Battersea. Seven are from Mortlake, six from the Battersea area, and three from Kew. In contrast, the individuals dated to the later, Medieval and Post-Medieval, periods were predominately recovered from the central and more eastern sections of the Lower Thames. Two Late Bronze Age individuals from the Maynard Reservoir assemblage are also present within the isotopic dataset.

8.1.2.2 Collagen preservation

All 42 samples had good collagen preservation for the measurement of carbon and nitrogen stable isotopes in bone. Overall collagen yields, %C, and %N all met the quality criteria of Ambrose (1990), and the C:N atomic ratios fell between 2.9-3.6 (DeNiro, 1985). The majority of samples also met the preservation criteria for the measurement of sulphur isotopes in mammalian bone collagen outlined by Nehlich and Richards (2009): C:S atomic ratios of 600±300, N:S atomic ratios of 200±100, and %S between 1.5-0.35%. Two samples, SK 19 and SK 4162, had %S values of 0.4 and therefore did not meet these quality criteria and are excluded from further sulphur analysis.

8.1.2.3 Human $\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$ values

The $\delta^{13}C$ values of the Thames remains ranged from -22.3‰ to -18.2‰, with a mean for all time periods of -20.2 ± 0.7‰, and the $\delta^{15}N$ values from 9.0‰ to 13.7‰, with a mean of 11.3 ±1.1‰ (Table 8.3). The $\delta^{34}S$ values had a broad range, from -16.2‰ to 16.3‰, with a mean of -0.2 ± 7.9‰ (Table 8.3). The $\delta^{34}S$ values were also very variable within each time period, with relatively large standard deviations around the mean (Table 8.3).

Period	***n***	***Mean $\delta^{13}C$ (‰)***	**σ**	**Mean $\delta^{15}N$ (‰)**	**σ**	***n***	**Mean $\delta^{34}S$(‰)**	**σ**
Neolithic	***3***	-21.4	0.8	10.6	0.3	***1***	-6.0	NA
Bronze Age	***13***	-20.5	0.4	11.0	0.6	***13***	-4.5	6.1
Iron Age	***11***	-20.4	0.3	11.3	0.9	***11***	-2.2	9.1
Roman	***4***	-19.6	0.7	11.5	1.7	***4***	7.8	4.5
Medieval	***6***	-19.9	0.5	11.2	1.8	***6***	3.7	5.7
Post-Medieval	***5***	-19.1	0.6	12.6	0.9	***5***	6.8	2.9
Total *n*	***42***	**-20.2**	**0.7**	**11.3**	**1.1**	**40**	**-0.2**	**7.9**

Table 8.3: Mean and standard deviation $\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$ values for the humans presented by time period.

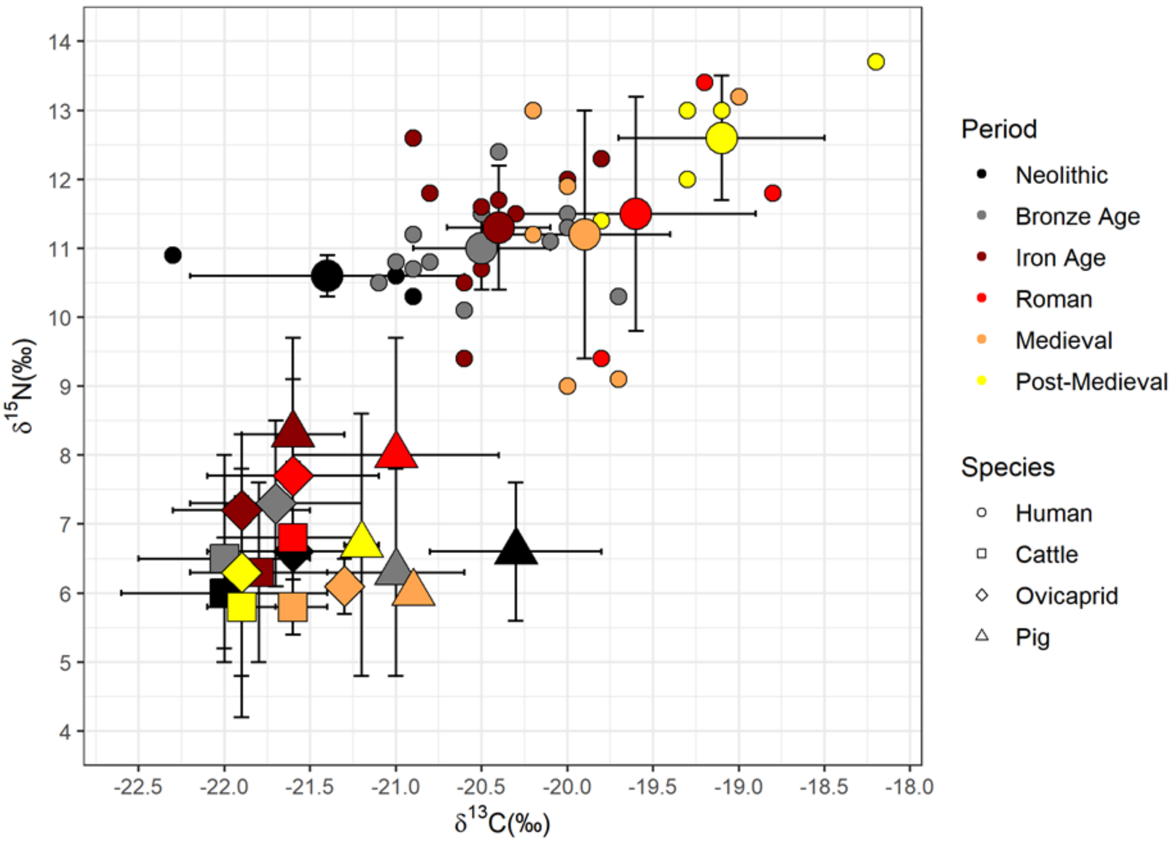

Figure 8.1: $\delta^{13}C$ and $\delta^{15}N$ values for the Thames humans (circles), colour-coded according to time period (black = Neolithic, grey = Bronze Age, dark red= Iron Age, bright red = Roman, orange = Medieval, yellow = Post-Medieval). The smaller single points represent individuals and larger points represent the mean and standard deviation values for each time period. The human data are plotted alongside the mean and standard deviation values for the faunal baseline dataset, which are similarly colour-coded according to time period and symbolised according to species (squares = cattle, diamonds = ovicaprids, triangles = pigs).

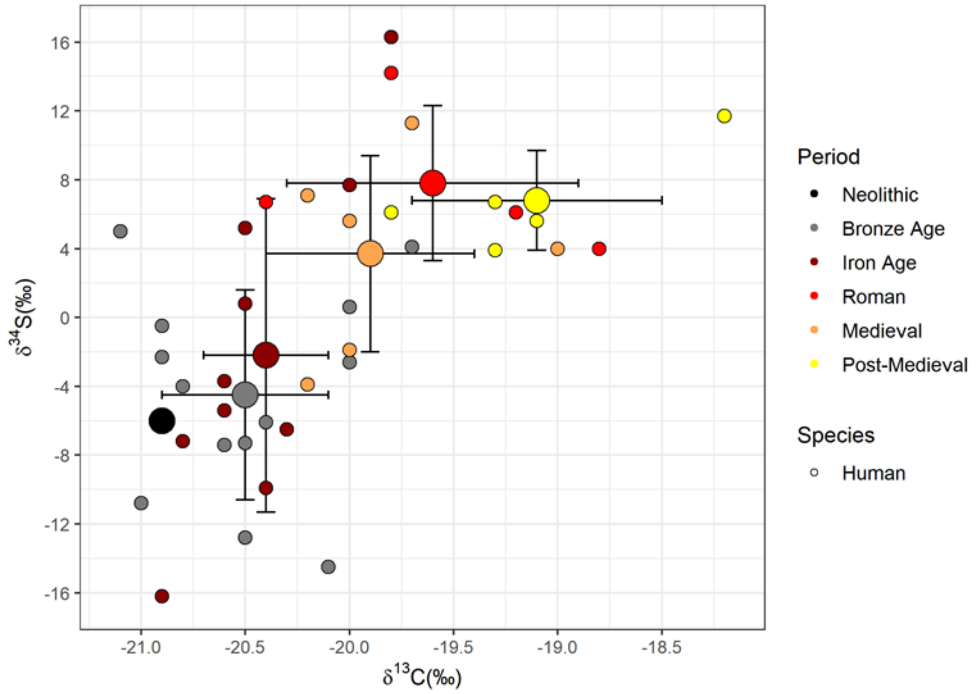

Figure 8.2: $\delta^{34}S$ and $\delta^{13}C$ values for the Thames humans, colour-coded according to time period (black = Neolithic, grey = Bronze Age, dark red= Iron Age, bright red = Roman, orange = Medieval, yellow = Post-Medieval). The smaller single points represent individuals and larger points represent the mean and standard deviation values for each time period.

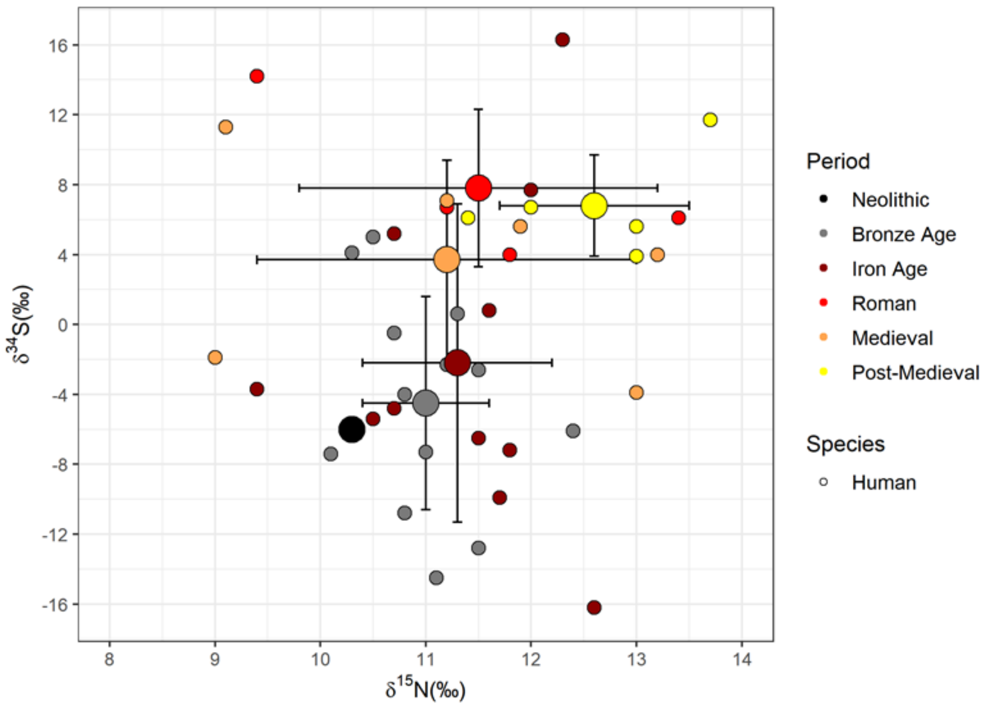

Figure 8.3: $\delta^{34}S$ and $\delta^{15}N$ values for the Thames humans, colour-coded according to time period (black = Neolithic, grey = Bronze Age, dark red= Iron Age, bright red = Roman, orange = Medieval, yellow = Post-Medieval). The smaller single points represent individuals and larger points represent the mean and standard deviation values for each time period.

There was a moderate positive correlation between $\delta^{13}C$ and $\delta^{15}N$ values (Pearson's correlation, *r*=0.466, *p=0.002*; Figure 8.4), and a strong positive correlation between $\delta^{13}C$ and $\delta^{34}S$ values (Pearson's correlation, *r*=0.591, *p*=<0.001; Figure 8.5). A weak positive correlation was observed between $\delta^{15}N$ and $\delta^{34}S$, but this was not statistically significant (Pearson's correlation, *r*=0.093, *p*=0.569; Figure 8.6). Where significant, the relationships are quantified using a linear regression fit to the data, with 95% confidence intervals shown in grey.

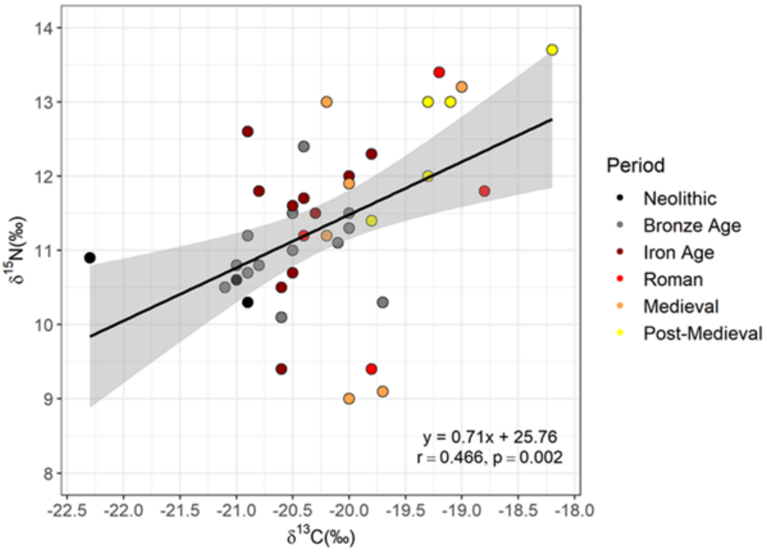

Figure 8.4: $\delta^{13}C$ and $\delta^{15}N$ values for the Thames humans, colour-coded according to time period (black = Neolithic, grey = Bronze Age, dark red= Iron Age, bright red = Roman, orange = Medieval, yellow = Post-Medieval). Each data point represents a single individual. A Pearson's correlation test identified a statistically significant, moderate positive relationship between increasing $\delta^{13}C$ and increasing $\delta^{15}N$ values (*r*=0.466, *p=0.002)*. The grey region represents the 95% confidence interval on the relationship.

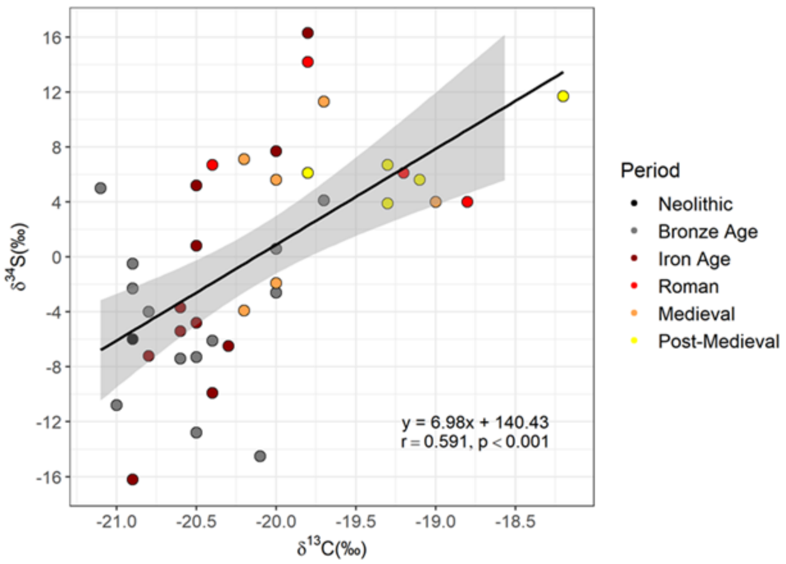

Figure 8.5: $\delta^{13}C$ and $\delta^{34}S$ values for the Thames humans, colour-coded according to time period (black = Neolithic, grey = Bronze Age, dark red= Iron Age, bright red = Roman, orange = Medieval, yellow = Post-Medieval). Each data point represents a single individual. A Pearson's correlation test identified a statistically significant, strong positive relationship between increasing $\delta^{13}C$ and increasing $\delta^{34}S$ values (*r*=0.591, *p<0.001)*. The grey region represents the 95% confidence interval on the relationship.

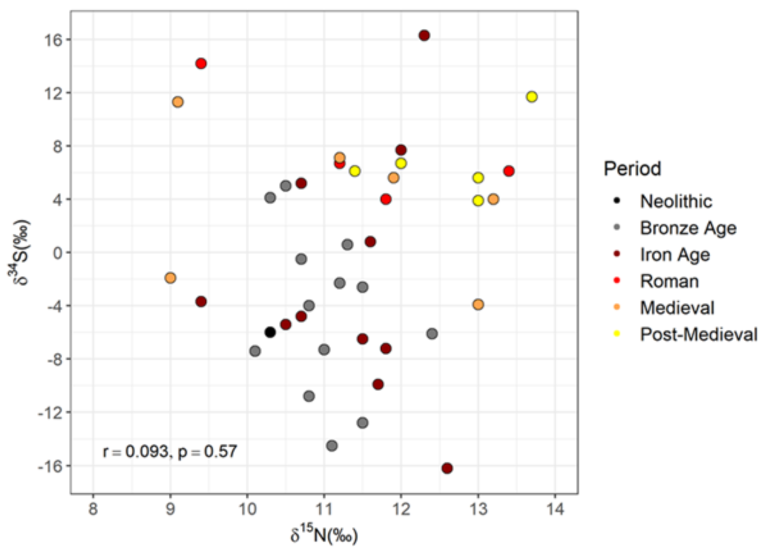

Figure 8.6: $\delta^{15}N$ and $\delta^{34}S$ values for the Thames humans, colour-coded according to time period (black = Neolithic, grey = Bronze Age, dark red= Iron Age, bright red = Roman, orange = Medieval, yellow = Post-Medieval). Each data point represents a single individual. A Pearson's correlation did not identify a statistically significant linear relationship between $\delta^{15}N$ and $\delta^{34}S$ values.

Temporal trends were observed for $\delta^{13}C$, $\delta^{15}N$, and $\delta^{34}S$, with a general increase in the values of all through time from the Neolithic to Post-Medieval periods (Figure 8.7). Statistically significant differences between time period isotopic values are presented in Table 8.4, alongside the relevant *p* values. Owing to the uneven sample sizes between periods it is difficult to examine the precise nature of these temporal trends (e.g., constant linear increases, versus step changes between one or more periods), however several observations can be made.

Time periods	$\delta^{13}C$	$\delta^{34}S$
	***p* value**	***p* value**
Neolithic-Roman	<0.001	-
Neolithic-Medieval	0.001	-
Neolithic-Post-Medieval	<0.001	-
Bronze Age-Roman	0.023	0.029
Bronze Age-Post Medieval	<0.001	0.029
Iron Age-Roman	0.048	-
Iron Age-Post-Medieval	<0.001	-

Table 8.4: Time period pairs with statistically significant differences between their mean isotopic values. The reported *p* values are for one-way ANOVA with post-hoc Bonferroni correction analysis.

For carbon, there was a general sequential increase in mean time period $\delta^{13}C$ values from the lowest value in the Neolithic, -21.4±0.8‰, to the highest value in the Post-Medieval period, -19.1±0.6‰ (Table 8.3 and Figure 8.7, A). However, the low mean Neolithic $\delta^{13}C$ value was influenced by a single individual (SK 4162) with a particularly low $\delta^{13}C$ value of -22.3‰, and the Bronze Age and Iron Age had very similar mean $\delta^{13}C$ values of -20.5‰ and -20.4‰, respectively. The general pattern of lower mean $\delta^{13}C$ values for the prehistoric periods (Neolithic, Bronze Age, Iron Age) and higher values for the historic periods (Roman, Medieval and Post-Medieval) was reflected in the presence of multiple statistically significant differences between, but not within, periods belonging to the two subgroups (see Table 8.4 for the *p* values). For instance: the Neolithic period mean $\delta^{13}C$ value was significantly lower than those of the Roman, Medieval, and Post-Medieval periods; the Bronze Age mean $\delta^{13}C$ value was significantly lower than those of the Roman and Post-Medieval periods; and the Iron Age mean $\delta^{13}C$ value was significantly lower than those of the Roman and Post-Medieval periods (Table 8.4).

For nitrogen, a sequential increase in mean time period $\delta^{15}N$ values was also observed, with the exception of the Medieval period which had a mean value of 11.2±1.8‰, which was lower than the mean values of both the preceding Roman period and Iron Ages (Table 8.3 and Figure 8.7, B). The low mean Medieval $\delta^{15}N$ value is largely driven by the presence of the two individuals with the lowest recorded $\delta^{15}N$ values in the overall dataset: SK 1551 who had a $\delta^{15}N$ value of 9.0‰, and SK 139 who had a $\delta^{15}N$ value of 9.1‰ (Table 8.2). None of the differences in mean $\delta^{15}N$ values between the time periods were statistically significant.

For sulphur, there was a general sequential increase in mean time period $\delta^{34}S$ values from the Neolithic to Post-Medieval periods, as with carbon (Table 8.3 and Figure 8.7, C). This temporal pattern is reflected in the fact that the mean Bronze Age $\delta^{34}S$ value, -4.5±6.1‰, was significantly lower than those of the Roman and Post-Medieval periods (p=0.029 for both, see Table 8.4). Similar to the situation for carbon, there appears to be a distinction in $\delta^{34}S$ values between the prehistoric (Neolithic, Bronze Age, Iron Age) and historic (Roman, Medieval, Post-Medieval) groups: the prehistoric groups all had negative mean $\delta^{34}S$ values, whereas the historic groups all had positive mean $\delta^{34}S$ values (Table 8.3). Only two out of 15 individuals (13.3%) belonging to the historic time periods had negative $\delta^{34}S$ values, whereas 18 out of the 25 prehistoric individuals (72.0%) had negative $\delta^{34}S$ values. There was also a larger separation in mean $\delta^{34}S$ between the historic and prehistoric groups than between any of the time periods within them: for instance, there was a 5.9‰ offset between the Iron Age and Medieval period mean $\delta^{34}S$ values. The Bronze and Iron Ages appear to be particularly similarly distributed in terms of their mean values and standard deviations (-4.5±6.1‰ and -2.2±9.1‰, respectively).

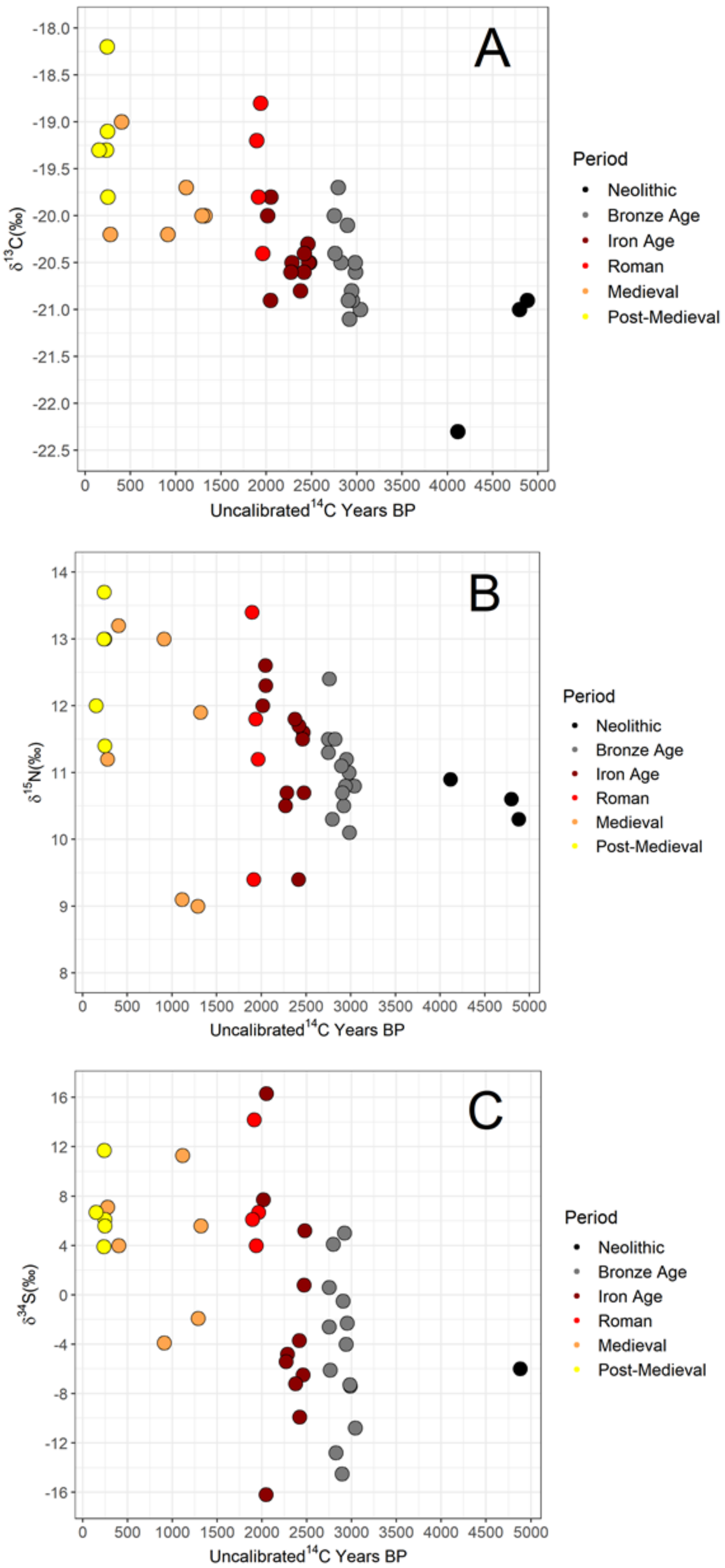

Figure 8.7: $\delta^{13}C$ (plot "A"), $\delta^{15}N$ (plot "B"), and $\delta^{34}S$ (plot "C") data for each Thames human individual, plotted against their corresponding uncalibrated radiocarbon date (years BP). Each data point represents a single individual and is colour-coded according to time period (black = Neolithic, grey = Bronze Age, dark red= Iron Age, bright red = Roman, orange = Medieval, yellow = Post-Medieval). There is a general increase in the values of each isotope through time from the Neolithic to Post-Medieval periods.

8.2 Discussion

The following discussion provides interpretations of the observed carbon, nitrogen, and sulphur isotopic data for the River Thames individuals. A general dietary reconstruction (Section 8.2.1) and comparison of the River Thames data with other Thames Valley sites (Section 8.2.2) based predominantly on the $\delta^{13}C$ and $\delta^{15}N$ results are provided first. This is followed by a separate discussion of the $\delta^{34}S$ results (Section 8.2.3), and a chapter summary (Section 8.3).

8.2.1 General dietary reconstruction

The $\delta^{13}C$ and $\delta^{15}N$ values indicate a diet mainly based on terrestrial C_3 resources for the majority of individuals. As previously described, an enrichment in $\delta^{15}N$ values of 3-6‰ is usually suggested to indicate one trophic level (Bocherens and Drucker, 2003; Hedges and Reynard, 2007; O'Connell et al., 2012). In each time period the human $\delta^{15}N$ values are at least ~3‰ higher than the mean faunal $\delta^{15}N$ for the relevant time period (see Table 8.1 for the faunal mean values). This suggests there was a significant contribution of animal protein resources to the diet of all individuals (e.g., meat, milk). This interpretation is consistent with other isotopic studies, and archaeological and historical evidence, which highlight the importance of meat and other domesticated animal products to diet from the Neolithic period onwards in Britain (e.g., Müldner and Richards, 2007; Hamilton and Hedges, 2011; Stevens et al., 2012; Bleasdale et al., 2019; Jay and Richards, 2019).

8.2.1.1 Aquatic resource consumption

Evidence for aquatic resource consumption was only present in the later, historic periods, which is consistent with expectations from archaeological and isotopic studies which indicate that, after the Mesolithic, such resources were only consumed in significant quantities from the Roman period onwards in Britain (e.g., Richards et al., 1998; Thomas, 2003; Dobney and Ervynyck, 2007; Jay, 2008; Jay and Richards, 2019). Aquatic resource consumption is generally indicated by $\delta^{15}N$ and $\delta^{13}C$ values enriched more than the estimated upper limit of a single trophic level compared to terrestrial faunal values (over 6‰ and 2‰ higher, respectively).

The Post-Medieval period provides the strongest evidence for aquatic resource consumption: the human $\delta^{15}N$ and $\delta^{13}C$ means were 6.3‰ and 2.6‰ higher,

respectively, than the Post-Medieval faunal means. Specifically, the $\delta^{13}C$ and $\delta^{15}N$ values of three of the five Post-Medieval individuals: SKs 1523, 1524, and 1549 indicate a degree of aquatic resource consumption. One Medieval individual, SK 4179, dated to the Late Medieval period (cal AD 1440-1615), also indicated a degree of aquatic resource consumption, with $\delta^{15}N$ and $\delta^{13}C$ values over 7.2‰ and 2.3‰ higher, respectively, than the Medieval faunal mean.

It appears most likely that these concurrently offset $\delta^{15}N$ and $\delta^{13}C$ values reflect the consumption of marine resources. In general, marine resources tend to have much higher $\delta^{13}C$ values than terrestrial fauna, whereas freshwater fish can vary widely (Schoeninger and DeNiro, 1984; Walker and Deniro, 1986; Dufour et al., 1999). Freshwater fish from the River Thames may have fairly low $\delta^{13}C$ values: four Medieval period freshwater fish from the Thames at Oxford were reported to have $\delta^{13}C$ values, ranging between -27.0‰ and -25.9‰, in a study by Nehlich et al., (2011). The co-occurrence of relatively high $\delta^{34}S$ values for these individuals also strengthens the case for marine resource consumption. Marine fish tend to have consistently high $\delta^{34}S$ values, averaging around 16.8±0.7‰, whereas freshwater fish, and specifically those from the Thames (Nehlich et al., 2011; see Section 8.2.3.1.1), often have lower $\delta^{34}S$ values (Nehlich, 2015). A single candidate freshwater resource consumer can be identified in the Medieval period: E 213 (cal AD 1035-1170) from Hampton had an elevated $\delta^{15}N$ value of 13.0‰, which is 7‰ higher than the medieval faunal mean, but a $\delta^{13}C$ value of -20.2‰, which is only ~1‰ higher than the faunal mean, and a low $\delta^{34}S$ value of -3.9‰.

In addition to the aforementioned Medieval and Post-Medieval individuals, two Roman period individuals may also have consumed a degree of marine food. SKs 4130 and 4137 had $\delta^{13}C$ values considerably over 2‰ greater than Roman faunal mean, though their $\delta^{15}N$ values were less than 6‰ higher. The enriched $\delta^{13}C$ values could reflect marine resource consumption, though the lack of corresponding enrichment in $\delta^{15}N$ values could instead reflect dietary intake of C_4 crops, such as millet, which were known to have been introduced in Britain during the Roman period, albeit on a small scale (Müldner, 2013).

Elevated $\delta^{13}C$ and $\delta^{15}N$ values could also be obtained via the consumption of large amounts of omnivore protein (e.g., pig) (Müldner and Richards, 2007). However, although the faunal baseline sample sizes are small for later periods, the pig $\delta^{15}N$ and

$\delta^{13}C$ values do not appear to be unusually high (Table 8.1), so this explanation is unlikely to wholly account for the elevated $\delta^{13}C$ and $\delta^{15}N$ values observed for the humans.

Although the aforementioned Post-Medieval, Medieval and Roman period individuals have been identified as potential aquatic resources consumers, it should be noted that is difficult to identify specific aquatic/non-aquatic resource consumers within the dataset with complete confidence for various reasons. For example, the extent to which the faunal baseline data, pooled from various Thames Valley sites, are relevant to the actual diet of the Thames humans is not known.

8.2.1.2 Temporal trends in $\delta^{13}C$ and $\delta^{15}N$: an increase in marine resource consumption

An increase in marine resource consumption in the later, historic, periods is likely in large part responsible for the observed temporal trends in $\delta^{13}C$ and $\delta^{15}N$, whereby the values of both present an increase over time from the Neolithic to the Post-Medieval periods. These changes are unlikely to reflect changes in the underlying bioavailable $\delta^{13}C$ and $\delta^{15}N$ values, as there was a lack of corresponding temporal trends in the faunal baseline $\delta^{13}C$ and $\delta^{15}N$ values (see Section 8.1.1). The statistically significant positive correlations observed in the overall dataset between $\delta^{13}C$ and $\delta^{15}N$ (Pearson's correlation, r=0.466, p=*0.002*; Figure 8.4), and between $\delta^{13}C$ and $\delta^{34}S$ (Pearson's correlation, r=0.591, p=<0.001; Figure 8.5), also provide support for this interpretation, as do the generally high $\delta^{34}S$ values in the Roman, Medieval and Post-Medieval periods.

Also in support of this marine resource interpretation is the fact that the change in $\delta^{13}C$ values appears to resemble a step change between prehistoric groups with lower $\delta^{13}C$ values (Neolithic, Bronze Age, Iron Age) and the historic periods with higher $\delta^{13}C$ values (Roman, Medieval, Post-Medieval), which is manifest in the presence of multiple statistically-significant differences between, but not within, these broad time periods. The timing of this change is in line with what would be expected based on archaeological and isotopic evidence, which suggest that marine resources were introduced to the diet in significant quantities from the Roman period onwards in Britain (Richards et al., 1998; Cool, 2006; Müldner and Richards, 2007; Müldner, 2013). There is substantial evidence specific to Roman London itself for the presence of marine food resources. For example, a fish sauce (*garum*) made of whitebait probably caught in the

Thames Estuary, was recovered from a 3rd century AD site near Billingsgate (Bateman and Locker, 1982; Locker, 2007). Oysters from the Thames Estuary have also been found as far afield as Leicester, suggesting a thriving oyster trade close to the city during the Roman period (Cool, 2006).

The fact that the Roman period had higher average $\delta^{13}C$ and $\delta^{15}N$ values than the subsequent Medieval period may appear slightly surprising, as the input of marine resources to diets may be expected to increase through time from the point of adoption (Müldner and Richards, 2007). However, it appears that the Roman period in Britain was an early anomaly in terms of its evidence for marine resource consumption (Müldner, 2013; Orton et al., 2017); multiple studies point towards the presence of a "Fish Event Horizon" at around 1000 AD, after which there is a significant increase in the proportion of marine fish species in archaeological assemblages in Britain (Barrett et al., 2004). Interestingly, the two Medieval individuals with the lowest $\delta^{15}N$ values (SK 1551 and SK 139, $\delta^{15}N$ values of 9.0‰ and 9.1‰, respectively) and who are therefore unlikely to have been marine resource consumers, are Early Medieval in date and predate the Fish Event Horizon.

8.2.2 Comparison of $\delta^{13}C$ and $\delta^{15}N$ data with other Thames Valley sites

The River Thames human $\delta^{13}C$ and $\delta^{15}N$ data are examined alongside published data for other Thames Valley sites in Figure 8.8. From this, it can be observed that the Thames $\delta^{13}C$ and $\delta^{15}N$ values are generally consistent with those of other temporally and geographically contemporaneous sites. For example, the Thames data is very similar to that produced for human remains from the nearby riverine site of Eton Rowing Course for the Neolithic to Roman periods. The Thames Iron Age individuals have slightly elevated $\delta^{15}N$ values (11.3±0.9‰) compared to Iron Age individuals from Eton (10.1±0.8‰) and Yarnton (10.7±1.0‰), although they are consistent with the Eton Bronze Age individuals. However, the sample sizes involved are small, and unevenly distributed in terms of date. Overall, the observed consistency is likely indicative of dietary similarity between the sites; the individuals from the other Thames Valley sites are likely to have had access to fauna with a broadly similar range of $\delta^{13}C$ and $\delta^{15}N$ values as the River Thames individuals, although site-specific differences are possible.

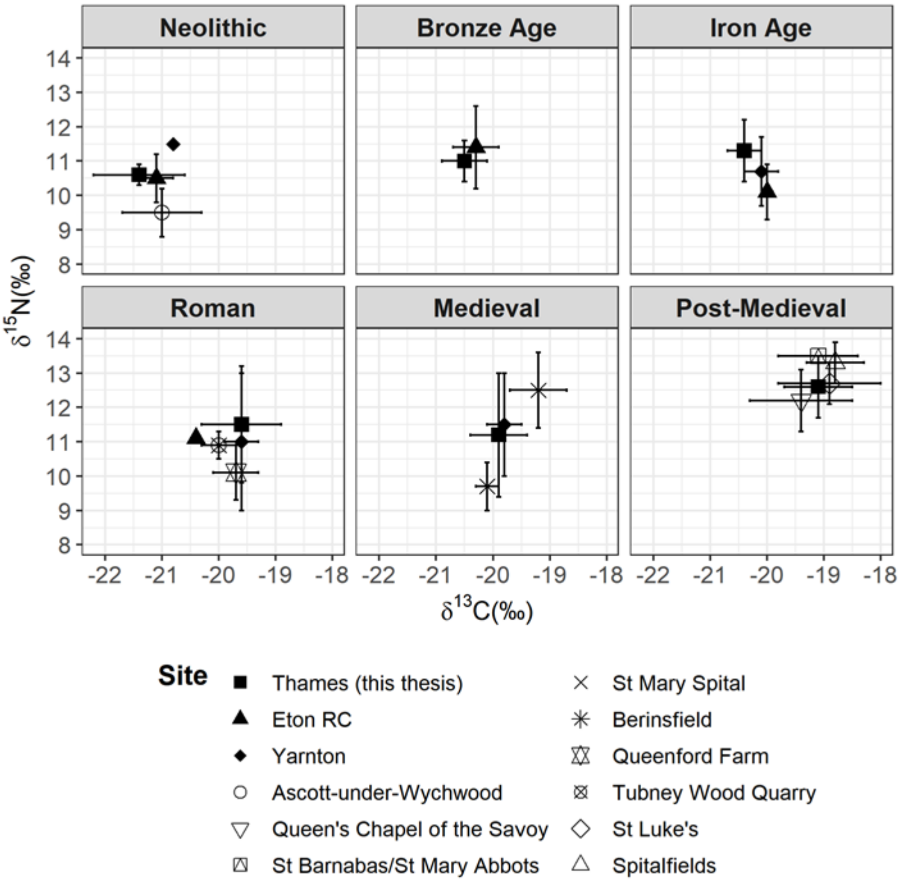

Figure 8.8: The Thames human mean and standard deviation $\delta^{13}C$ and $\delta^{15}N$ data (black squares) for each time period (Neolithic to Post-Medieval) shown alongside comparative data for individuals of the same periods from other Thames Valley sites. Black triangles= Eton Rowing Course (Stevens et al., 2012), black diamond= Yarnton (Lightfoot et al., 2009), circle= Ascott-under-Wychwood (Hedges et al., 2006), inverted triangle= Queen's Chapel of the Savoy (Bleasdale et al., 2019), triangle inside square= St Barnabas/St Mary Abbots (Bleasdale et al., 2019), cross= St Mary Spital (Walter et al., 2020), asterisk= Berinsfield (Privat et al., 2002), star= Queenford Farm (Fuller et al., 2006), cross inside circle= Tubney Wood Quarry (Nehlich et al., 2011), diamond= St Luke's (Trickett, 2006), triangle= Spitalfields (Nitsch et al., 2010).

8.2.3 Sulphur

The River Thames human $\delta^{34}S$ values were highly variable, ranging from -16.2‰ to 16.3‰; which is the largest range, and includes some of the lowest $\delta^{34}S$ values, so far found for humans in any European archaeological context (Richards et al., 2001; Privat et al., 2007; Nehlich et al., 2010; Linderholm and Kjellström, 2011; Nehlich et al., 2011; Jay et al., 2013; Linderholm et al., 2014; Nehlich et al., 2014; Sayle et al., 2016; Jay et al., 2019; Walser et al., 2020). There was a notable increase in $\delta^{34}S$ values through time from the Neolithic to the Post-Medieval periods. As with carbon, there appears to be a broad distinction between prehistoric groups with lower, generally negative, $\delta^{34}S$

values, and historic groups with higher, generally positive, $\delta^{34}S$ values. The mean of the Bronze Age individuals (-4.5±6.1‰) was statistically lower than those of the Roman and Post-Medieval periods (7.8±4.5‰ and 6.8±2.9‰, respectively). The River Thames individuals are presented by time period alongside existing $\delta^{34}S$ data from other British archaeological contexts in Figure 8.9.

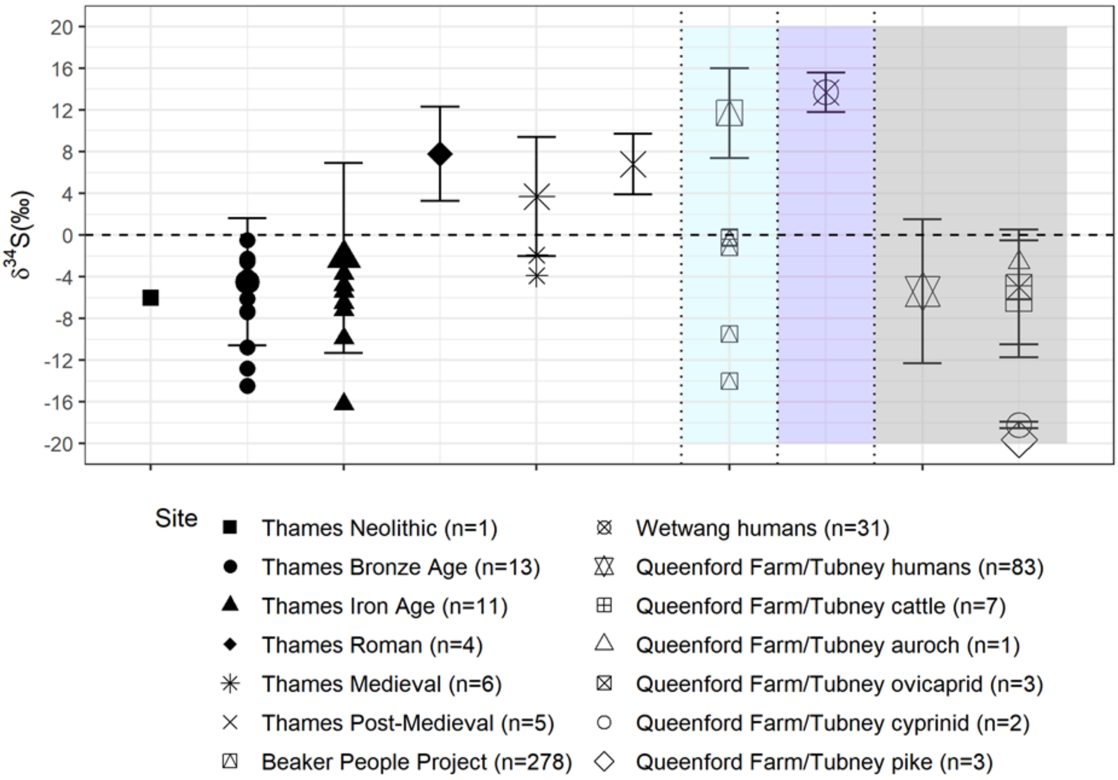

Figure 8.9: Mean and standard deviation $\delta^{34}S$ values for the Thames human individuals (unshaded region), shown alongside comparative data from other British sites. The Thames human data are presented by time period: black squares= Neolithic, black circle= Bronze Age, black triangle= Iron Age, black diamond= Roman, asterisk= Medieval, cross= Post-Medieval. Thames individuals with $\delta^{34}S$ values below 0‰ are plotted separately. Blue shaded region= the Beaker People Project human data (Jay et al., 2019). The four individuals with bone $\delta^{34}S$ values below 0‰ are plotted separately in addition to the mean and standard deviation. Purple shaded region= Wetwang slack human data (Jay et al., 2013). Grey shaded region = human (star) and fauna (other symbols) data from the Upper Thames Roman period sites of Queenford Farm and Tubney Wood Quarry (Nehlich et al., 2011). The number of individuals present within each dataset is indicated in the legend.

Although the Thames individuals cover a broad geographic range, from Hampton in the western reaches of the Lower Thames, to Northfleet in the Thames Estuary, broad scale spatial factors are not likely to have greatly affected the variation in $\delta^{34}S$ values across the dataset. For example, the $\delta^{34}S$ values of the underlying bedrock are not likely to account for the pattern observed in the Thames individuals, as they are underlain by formations with highly congruous geological compositions. All of the Thames individuals were recovered from areas underlain by the Thames Group, the Lambeth Group, or the Thanet Formation, which all consist of clay, sand, and silt, with the addition of gravel for the Thames and Lambeth Groups. There is one exception however: SK 1526, a Late Iron Age cranium was recovered from Northfleet, an area underlain by the White Chalk Subgroup. Interestingly, SK 1526 had a $\delta^{34}S$ value of 16.3‰, which is the highest in the overall dataset, and is 18.5‰ above the Iron Age mean. This value is consistent with those obtained for Iron Age humans and fauna underlain by the same chalk geology in Hampshire (Suddern Farm and Danebury) and Yorkshire (Wetwang Slack), which ranged between 12.9‰ and 18.8‰ (Jay et al., 2013; Hamilton et al., 2019; see Figure 8.9).

The sea spray effect, whereby enriched marine sulphur can be transported inland via precipitation and aerosols (Nielsen, 1974; Mizota and Sasaki, 1996; Nehlich, 2015), is also unlikely to be particularly relevant to the Thames individuals. Only SK 1526 from Northfleet, the most easterly located individual, is comfortably within the generally hypothesised range of the sea spray effect (around 20-30 km inland), and for the British Isle the effect is thought to be stronger on the west coast than the east, probably owing to the effect of the prevailing wind direction (Zazzo et al., 2011). SK 1526 does have the highest $\delta^{34}S$ value observed in the dataset; though, as stated previously, this high value may be largely driven by the underlying chalk geology, and it is within the range of $\delta^{34}S$ values presented for other humans and fauna with the same geology from inland sites (Jay et al., 2013; Hamilton et al., 2019).

These spatial factors are unlikely to have significantly affected the observed variation in $\delta^{34}S$ values. Instead, the consumption of marine foods is likely to be at least partially responsible for higher $\delta^{34}S$ values observed in the later, Roman, Medieval, and Post-Medieval Periods. As aforementioned in Section 8.2.1.2, this interpretation is also supported by the $\delta^{13}C$ and $\delta^{15}N$ data, including the presence of a statistically significant positive correlation between $\delta^{34}S$ and $\delta^{13}C$ (Pearson's correlation, r=0.591, p=<0.001; Figure 8.5).

However, it appears that the primary reason for the strong temporal variation in $\delta^{34}S$ may be that there are unusually depleted $\delta^{34}S$ values in the earlier prehistoric periods, and this forms the focus of the subsequent discussion.

8.2.3.1 Highly depleted $\delta^{34}S$ values for prehistoric period individuals

The depleted $\delta^{34}S$ values found for the prehistoric, Neolithic (6.0‰, n=1), Bronze Age (-4.5±6.1‰, n=13), and Iron Age (-2.2±9.1‰, n=11) groups are highly unusual, and represent some of the lowest $\delta^{34}S$ values so far found in any British or wider European archaeological context (Richards et al., 2001; Privat et al., 2007; Nehlich et al., 2010; Linderholm and Kjellström, 2011; Jay et al., 2013; Linderholm et al., 2014; Nehlich et al., 2014; Sayle et al., 2016; Jay et al., 2019; Walser et al., 2020).

The recent Beaker People Project perhaps provides the strongest comparison sample to demonstrate this result. The Beaker People Project produced the largest archaeological sulphur isotope dataset for Britain to date, performing $\delta^{34}S$ analysis on Early Bronze Age (2500-1500 BC) skeletal remains from across Britain, covering a range of different geological and geographical environments (Jay et al., 2019). The mean $\delta^{34}S$ value for bone collagen was 11.7±4.3‰, and only four out of the 278 Bronze Age individuals analysed as part of the project had bone collagen $\delta^{34}S$ values below zero (see Figure 8.9, where these individuals are plotted individually). By contrast, half of the individuals in this study (20/40) had $\delta^{34}S$ values below zero (plotted individually in Figure 8.9). Aside from two Medieval individuals, these individuals with $\delta^{34}S$ values below zero were all dated to the Neolithic (n=1/1), Bronze Age (n=10/13), and Iron Age (n=7/11). Overall, 72% (18 out of 25) of the prehistoric individuals had negative $\delta^{34}S$ values.

Interestingly however, the prehistoric Thames $\delta^{34}S$ values are very similar to the depleted values found for 83 Roman period human remains and a range of fauna from two sites situated close to the River Thames in the Upper Thames Valley: Queenford Farm and Tubney Woods (Nehlich et al., 2011; plotted in the grey region in Figure 8.9). The combined human mean $\delta^{34}S$ value for individuals from the two sites was -5.4±6.9‰ and 65/83 individuals had $\delta^{34}S$ values below zero.

8.2.3.1.1 The influence of the freshwater River Thames

Factors relating to the proximity to the freshwater ecosystem may be relevant to the observed prehistoric depletion in $\delta^{34}S$ values. All of the prehistoric Thames individuals were recovered from stretches of the Thames which are likely to have been freshwater during the lifetime of each individual. As outlined in Section 3.1.1, the tidal head is known to have been at Westminster during the Bronze Age and to have moved downstream subsequently to this by the Roman period (Brigham and Hillam, 1990; Sidell et al., 2000). The prehistoric individuals were largely recovered upstream of this: from Kew (n=3), Mortlake (n=9), Battersea/Chelsea (n=8). Two of the Late Bronze Age individuals are from the Maynard Reservoir assemblage on the River Lea, a freshwater tributary to the Thames.

Freshwater ecosystems are notably variable in their $\delta^{34}S$ values; organisms from freshwater environments have been demonstrated to range between -22‰ and 20‰ (Richards et al., 2001; Sayle et al., 2013). However, relatively low $\delta^{34}S$ values can be hypothesised for the relevant stretches of the River Thames in the prehistoric period. Low $\delta^{34}S$ values were identified for River Thames water by Nehlich et al., (2011) through the $\delta^{34}S$ values produced for cyprinids and pike from Medieval Oxford (-18.2±0.3‰ and -19.6±2.0‰, respectively; see Figure 8.9), and may have arisen through the leaching of depleted $\delta^{34}S$ from pyritic sulphites in the Oxford Clay formation through which the Thames bed passes. Even though these values were reported further upstream and for the Medieval period, it is possible that similar values would have been present further downstream in the prehistoric period. Soluble sulphur can be transported over large distances in river water (Nehlich, 2015). Furthermore, the Thames Group formation which underlies the majority of the study area is also rich in pyrites (Bagheri and Rezania, 2020), which were found to be depleted in $\delta^{34}S$ in the Oxford Clay. Interestingly, $\delta^{34}S$ values as low as -5‰ have been identified in modern fish species from the River Thames at Kew, despite the fact that the water here is slightly saline in the present day (Leakey et al., 2008). However, caution must be applied to these modern $\delta^{34}S$ values, as modern environments can be affected by industrial pollution (Nehlich, 2015).

8.2.3.1.2 Evidence for the consumption of freshwater fish?

Freshwater fish consumption would be a potential explanation for the lower $\delta^{34}S$ values observed in the prehistoric individuals. As outlined above, Nehlich et al., (2011) found that archaeological freshwater fish from the Thames had low $\delta^{34}S$ values, and low $\delta^{34}S$ values for the freshwater stretches of the Thames are hypothesised in general. However, higher $\delta^{15}N$ values than those observed would be expected for the prehistoric individuals if freshwater fish formed a substantial part of the diet. There was also no correlation between $\delta^{34}S$ and $\delta^{15}N$ values in the overall dataset (Pearson's correlation, r=0.093, p=0.569; Figure 8.6), which may also be expected if freshwater fish contributed substantially to the diet of the Thames individuals. Furthermore, freshwater fish generally tend to be depleted in $\delta^{13}C$ (Müldner and Richards, 2007; Jay, 2008); and the freshwater Thames fish analysed by Nehlich et al., (2011) also had very low $\delta^{13}C$ values (means of -26.8±0.3‰ for carp, -26.4±0.4‰ for pike). These low $\delta^{13}C$ values are not reflected in the prehistoric Thames human data, which present slight enrichment compared to terrestrial animals. A negative correlation between $\delta^{34}S$ and $\delta^{13}C$ may also be expected for the prehistoric periods if freshwater resources were consumed. However, there is a statistically significant positive correlation between $\delta^{13}C$ and $\delta^{34}S$ in the overall dataset, which is maintained if just the prehistoric period is examined (Pearson's correlation, r=0.399, p=0.048).

The lack of evidence for freshwater fish consumption among the prehistoric Thames individuals is consistent with broader isotopic and archaeological evidence, which suggests there was no widespread fish consumption in prehistoric Britain, even at sites close to large bodies of water (e.g., Jay, 2008; Stevens et al., 2012; Parker Pearson et al., 2019). However, it is interesting to note that sulphur concentrations are higher in the tissues of fish muscle than mammalian muscle, so the effect of fish consumption on the $\delta^{34}S$ value in humans may therefore be stronger than that seen in $\delta^{15}N$ or $\delta^{13}C$ values (Nehlich, 2015; Jay et al., 2019). Therefore, although there is currently no strong evidence to support the role of freshwater fish consumption in the depleted $\delta^{34}S$ values of the prehistoric Thames individuals, it is not possible to altogether rule it out as a possibility at this stage. The discovery of eel traps and fish weirs at the Late Bronze Age wetland site of Must Farm in Cambridgeshire (Knight et al., 2019) is interesting to note in relation to this. Further research may yield better understanding of the relationship between fish and consumer $\delta^{34}S$, $\delta^{13}C$, and $\delta^{15}N$ values.

8.2.3.1.3 Evidence for the Prehistoric utilisation of the Thames floodplain?

Processes of periodic overbank flooding, and potentially also waterlogging, on the Thames floodplain may have produced the depleted $\delta^{34}S$ values observed in the prehistoric Thames individuals. Similar processes have been implicated in a number of studies in different environments where unusually depleted $\delta^{34}S$ values have been observed (Nehlich et al., 2011; Jay et al., 2019; Reade et al., 2020b, a). For example, all of the 12 individuals with bone or dentine $\delta^{34}S$ values below 1‰ in the Beaker People Project were buried on, or very close to, river floodplains or wetland areas (Jay et al., 2019:352-353). Of particular relevance to the Thames remains, the depleted $\delta^{34}S$ values reported by Nehlich et al., (2011) for humans and fauna at two sites in the Upper Thames Valley were associated with the deposition of riverine sulphur with low $\delta^{34}S$ values on the floodplain during flooding events.

Flooding events, linked to a rising water table, increased in frequency and severity in the River Thames Valley from the Middle Bronze Age, and continued throughout the Late Bronze and Iron Ages (Lambrick and Robinson, 2009). Similarly to the process inferred by Nehlich et al., (2011) for the Roman period Upper Thames sites, such flooding events may have deposited riverine sulphur with low $\delta^{34}S$ values on to the floodplain surface. Once deposited, the depleted $\delta^{34}S$ could then have passed into the terrestrial food chain, most likely via animals grazing on the affected areas of the floodplain. At the Upper Thames sites studied by Nehlich et al., (2011), all of the terrestrial fauna presented very low $\delta^{34}S$ values, below zero, suggesting the input of riverine $\delta^{34}S$ sources (see Figure 8.9). Evidence for the use of low-lying areas of the floodplain as grazing pasture is present at a range of prehistoric Thames Valley sites (Lambrick and Robinson, 2009). For example, at the Eton Rowing Course site which is only a little way upstream of the study area, islands in the river were being used a grazing pasture in the prehistoric period (Allen et al., 2000). Of specific relevance to the Late Bronze Age Maynard Reservoir individuals (SKs 4191 and 3311) which have depleted $\delta^{34}S$ values, there is also evidence for Late Bronze Age grazing along the River Lea floodplain (Ritchie et al., 2008).

Waterlogging, which could arise in combination with this flooding, may also have contributed towards the observed depleted $\delta^{34}S$ values. Waterlogged/low oxygen soils are sometimes related to low $\delta^{34}S$ values (e.g., -20‰), possibly via the bacterial reduction of sedimentary sulphides in anaerobic sediments (Groscheová et al., 2000;

Nitsch et al., 2019; Reade et al., 2020a, b). Direct evidence exists for the use of waterlogged areas of the floodplain as grazing pasture in the Thames Valley during the Bronze and Iron Ages (Lambrick and Robinson, 2009:48).

As aforementioned, the $\delta^{34}S$ values of the prehistoric period individuals were highly variable: the Bronze Age values ranged from -14.5‰ to 5.0‰, and the Iron Age from -16.2‰ to 7.7‰ (excluding SK 1526). It is possible that some of this variation reflects underlying variability in the terrestrially bioavailable $\delta^{34}S$ values within the local food-sourcing area. For example, variability in human $\delta^{34}S$ values could arise via the differential utilisation of land both closer to, and further away from, the river for grazing, with lower and higher $\delta^{34}S$ values respectively. This was the explanation favoured by Nehlich et al., (2011) to account for some of the variability observed in their terrestrial fauna and human $\delta^{34}S$ values. Variation could also potentially represent wetter/drier periods in general: for example, the $\delta^{34}S$ values of plants growing in periodically waterlogged areas have been noted to vary as much as 4-11‰ between wetter and drier months (Nitsch et al., 2019). However, short term environmental variations in $\delta^{34}S$ values may not be reflected in bone collagen values, as they reflect an average of the dietary values consumed over the last years of life.

For the prehistoric period, there is no obvious variation in $\delta^{34}S$ values which would suggest the mobility of people from regions with different locally-bioavailable $\delta^{34}S$ values, e.g., from chalk areas with higher baseline $\delta^{34}S$ values (12.9‰ -18.8‰) (Jay et al., 2013; Hamilton et al., 2019). In fact, their unusually depleted $\delta^{34}S$ values, likely due to the consumption of floodplain-derived resources, may link many of the prehistoric Thames individuals directly to the communities living alongside the River Thames, as least for a large part of their later life. This finding means that, whatever the actual depositional processes which lead to the inclusion of the prehistoric individuals in the river deposits, they involved people who had been living in Thames-side communities, at least for the later years of their lives.

8.3 Chapter summary

The isotopic data presented for the River Thames human remains indicated diets based on terrestrial C_3 resources, and which included the consumption of animal protein, for individuals from all time periods. Aquatic, mainly marine, resource consumption was identified for individuals within the Roman, Medieval, and Post-Medieval periods, and marine resource consumption is likely to have been a major factor driving the observed temporal trends in $\delta^{13}C$ and $\delta^{15}N$ values.

For each time period, the River Thames human $\delta^{13}C$ and $\delta^{15}N$ data were highly consistent with that presented for other Thames Valley sites. This suggests that the Thames individuals did not differ greatly from other spatially and temporally contemporaneous groups in terms of diet, as least as far as can be isotopically accessed. This could have relevance for interpretations of their riverine deposition, as diet has the potential to reflect aspects of social identity (e.g., Richards et al., 1998; Dhaliwal et al., 2020).

The prehistoric Thames individuals were found to have unusual, highly depleted $\delta^{34}S$ values, which are among the lowest found in any Holocene European context to-date. These low values are considered likely to have arisen through processes of flooding and waterlogging which may have depleted the bioavailable $\delta^{34}S$ values of grazing land on the Thames floodplain. If this were the case, many of the prehistoric individuals probably lived locally to the immediate River Thames floodplain area, at least in the later years of their life. The overall temporal trend in $\delta^{34}S$ is likely to be largely driven by the presence of these very low $\delta^{34}S$ values in earlier periods, but the higher $\delta^{34}S$ values in the later periods are also likely to reflect the consumption of marine food resources in these periods, mirroring the findings from the $\delta^{13}C$ and $\delta^{15}N$ values.

However, to have confidence in these interpretations of the Thames human $\delta^{34}S$ dataset, comprehensive faunal baseline $\delta^{34}S$ datasets specific to the Middle and Lower Thames for the periods in question are required. Such data would help to develop a picture of the locally-bioavailable $\delta^{34}S$ in each time period, the $\delta^{34}S$ values of different food sources, and in particular the manner in which riverine sulphur inputs and waterlogging may be responsible for the depleted values observed in the prehistoric period individuals. Constraining the range of “local” $\delta^{34}S$ values is particularly important to confirm whether the prehistoric individuals with depleted $\delta^{34}S$ values can be strongly

linked to the immediate River Thames floodplain area. This hypothesis could also be further explored using supporting strontium and oxygen isotopic analysis.

Overall, these isotopic findings provide a novel perspective on diet across nearly 6000 years in the London area, and could have various implications for current understandings of the riverine deposition of prehistoric period individuals (discussed further in Chapter 9). The potential link between the depleted $\delta^{34}S$ values and the floodplain environment also has potential to contribute to understandings of the exploitation of the Thames floodplain by prehistoric communities, and the mobility of individuals within these communities. Furthermore, it may add to the emerging body of literature supporting a link between depleted $\delta^{34}S$ values and floodplain environments.

Chapter 9 <u>Discussion</u>

This chapter presents a discussion of deposition for specific subsets of the River Thames assemblage, drawing together aspects of the results and discussion presented separately in the preceding chapters (5-8): Section 9.1 focuses on the time periods sampled by the River Thames assemblage for which the combination of the new results and wider context can give particular insight into deposition; Section 9.2 discusses aspects of deposition for the Maynard Reservoir assemblage; and Section 9.3 gives a discussion of the main limitations. The focus here is on predominant depositional themes, as opposed to a discussion of all possible contributory depositional circumstances. It is acknowledged that numerous different depositional factors could have operated across and within each time period to contribute to the River Thames assemblage.

9.1 The River Thames assemblage

9.1.1 The Bronze Age (c. 2300-800 BC)

Sixteen individuals of known Bronze Age date were present in the Thames assemblage (see Section 6.1.2.2), seven of which were dated as part of this thesis. Three were of Early Bronze Age date (c. 2300-1600 BC) and two were of Middle Bronze Age date (c. 1600-800 BC) but the majority, 11 individuals, were of Late Bronze Age date (c. 1200-800 BC).

As outlined in Chapter 3 (Section 3.1.3), the Early Bronze Age funerary record in the Lower Thames Valley is limited, but hints at a complex sequence of funerary practice, with evidence for some inhumation in ring ditches, barrows, and some cremated bone deposits (Brown and Cotton, 2000). It is possible that individual GEN01 52 (2460-2140 cal BC) recovered from Syon Reach, reportedly in association with a “pile dwelling”, could have originated from a dryland context. There is direct evidence of the erosion of dryland Bronze Age deposits in the area: Needham and Burgess (1980:445) described how a Late Bronze Age dryland metalwork hoard was eroding from the riverbank at Syon Park. Furthermore, this individual presented stage 3 weathering, indicating a prolonged period of subaerial exposure (though this could have been obtained in a variety of ways, see Section 6.3.2.3). GEN01 52 is also an interesting individual in terms of their potential social identity within Early Bronze Age society. They were a female individual (genetically determined, Booth 2019), with five substantial

antemortem injuries (Section 7.6.2.2.1, Figure 7.6). Of further interest, their genetic ancestry (as determined by Booth, 2019) is consistent with that of individuals associated with Bell Beaker culture in continental Europe, and has no detectable input from populations that lived in Britain during the preceding Neolithic. This suggests that they could have been a first generation migrant to Britain: part of the migration of people from the area of the Netherlands that is associated with the development of Bell Beaker culture in Britain (Booth, 2019). However, it is also possible they were descended from a group of migrants who had arrived years before they were born, but who had not mixed substantially with local populations (Booth, 2019). Thus, the question of whether the funerary treatment of this individual could have been associated in some way with their social identity is an interesting idea to consider.

Also potentially connected with the concept of social identity is GEN01 59 (1870-1610 cal BC), a probable male calotte with a large antemortem trepanation (Section 7.6.2.2.1, Figure 7.7). This individual was recovered from the foreshore at Chelsea in 2001, and was reported to have been partially embedded in the remains of a submerged Neolithic forest (Edwards et al., 2009). In light of the date of the calotte and of the forest bed, it is possible that the deposition of this individual occurred in a submerging landscape: large scale environmental changes were taking place at this time in the Lower Thames Valley, with the submergence of former dryland surfaces (see Section 3.1.1). As outlined in Chapter 2 (Section 2.2.1.1), ritual depositions in water are often linked with processes of environmental change. However, it is also important to bear in mind the potential role of flooding in the erosion of dryland burials (e.g., Harward et al., 2015). It is interesting to consider whether the social identity of this individual (i.e., trepanned) could have been connected to their potential intentional deposition in a wetland environment, though as outlined in Section 7.7.2.3, it is unclear whether trepanned individuals had any particular social status within later prehistoric communities (e.g., Roberts and McKinley, 2003).

Compared to the preceding periods, there is a substantial increase in the number of individuals radiocarbon dated to the Late Bronze Age, with 11 individuals known. At the end of Chapter 6 (Section 6.2) it was argued that a large proportion of the remaining undated individuals (175 individuals) are perhaps likely to be of Late Bronze, or Iron Age, date.

It is unlikely that the majority of these remains could have originated from dryland burial contexts. This is, in part, due to the paucity of evidence for such practices in the Lower

Thames region at this time (see Section 3.1.3). Another relevant factor is the male bias which was identified in the known Bronze Age individuals (71% (10/14) of sexed individuals were males and 29% (4/14) were females), and in the overall assemblage (see Section 7.2.2.2). This pattern is unexpected based on the patterns for dryland burial contexts of the Late Bronze and Iron Age date, but is in-keeping with patterns identified for other watery assemblages (see Section 7.2.2.2 and Table 7.1).

Nevertheless, it is plausible that at least some of these Late Bronze Age individuals may have originated from dryland contexts. Human remains of Late Bronze Age date have been identified in various dryland contexts very close to the River Thames channels/former channels, or on former eyots in the river, as outlined with several examples in Section 3.1.3.3. The widespread utilisation of riverside sites in the Late Bronze Age (e.g., Brown, 2003), combined with changing river dynamics, both in the Late Bronze Age where there is evidence for flooding events (e.g., Lambrick and Robinson, 2009, see Section 3.1.1) and subsequently, could conceivably have led to the erosion of some of these deposits. For example, at Runnymede Bridge, processes of erosion had already begun in the Late Bronze Age (Needham, 1991:3). Any human remains within these dry contexts would then have been incorporated in to the main river channels. However, such processes are not likely to have contributed substantially to the Late Bronze Age portion of the Thames assemblage, as only small quantities of bone have been identified in these dryland contexts (Thomas et al., 1986; Needham, 1991; Bell, 1996; Cromarty et al., 2006).

As previously argued by Bradley and Gordon (1988), and later by Schulting and Bradley (2013) (see Section 3.2.3.1), there is evidence to support the idea that many of the Late Bronze Age Thames individuals could have been intentionally deposited in the river, and potentially in a form of ritual deposition. As outlined in Section 2.2.1, there is a demonstrably strong general relationship between watery contexts and Late Bronze Age funerary practices, both in Britain and more widely. Various possible examples of this relationship can be identified at sites along the Thames Valley, with human remains located in or near waterholes (See Section 3.1.3.3 for examples). This ritual deposition could, as also argued by Bradley and Gordon (1988) and Schulting and Bradley (2013), have been connected in some way with the deposition of metalwork, and particularly weaponry, in the river, which dramatically increased in the Middle Bronze Age and into the Late Bronze Age (Needham and Burgess, 1980; York, 2002).

This thesis provided the first evidence for skeletal trauma on individuals of a known Late Bronze Age date in the River Thames assemblage, with two trauma affected individuals identified (see Section 7.6.2.2.1). Together with the male bias identified for the Late Bronze Age and the overall assemblage, this could hint at a similar deposition pattern to that which will be hypothesised for the Iron Age, relating to martial activities (see Section 9.1.2 below). There is evidence that much of the Bronze Age River Thames weaponry was used (York, 2002; Thorpe, 2013), perhaps suggesting it did not have a solely symbolic role (e.g., Wells, 2020). Thorpe (2013) noted that the Bronze Age daggers from the River Thames provide evidence for combat damage, which is otherwise rare in Britain. Radiocarbon dating of the remaining undated trauma-affected individuals would help to further establish whether a link between martial activity and the deposition of human remains may have developed in the Late Bronze Age.

9.1.2 The Iron Age (c. 800 BC- AD 43)

There are currently 15 individuals of known Iron Age date in the Thames assemblage, seven of which were dated as part of this thesis, and three of which have been recovered from the present day foreshore in the last 20 years (all from Putney) (See Chapter 6). This reflects a substantial increase (almost double) in the known Iron Age portion of the assemblage compared to the data available for previous studies (Bradley and Gordon, 1988; Knüsel and Carr, 1995; Edwards et al., 2009; Schulting and Bradley, 2013). As considered in Chapter 6 (Section 6.2), a large portion of the undated assemblage (175 individuals) are likely to be of Late Bronze Age or Iron Age date.

It can be considered unlikely that the majority of these individuals originated from Iron Age dryland burial contexts, either eroded into the river through fluvial processes, or as in-situ burials. In part this is because, as highlighted by Schulting and Bradley (2013:68) and in Chapter 3 (Section 3.1.3), there is very little evidence for these forms of burial practice in the Lower Thames region during the Iron Age. For example, no Iron Age remains were encountered in dryland contexts at the site of Eton Rowing Course on the Middle Thames, though burials of Neolithic to Late Bronze Age date, and then of Roman date, were (Allen et al., 2000). Furthermore, as demonstrated in Chapter 7 (Section 7.2), the demographic profiles of the known Iron Age individuals and of the overall assemblage, presented a considerable male bias. This was demonstrated to be inconsistent with patterns identified for Iron Age dryland burials elsewhere in Britain, such as the pit and inhumation burials of the Upper Thames Valley (Lambrick and

Robinson, 2009; see Table 7.1, and Section 7.2.2.2), and can additionally be used to argue against a largely dryland origin for the Iron Age individuals.

The river foreshore at Putney is nevertheless an interesting site to consider in relation to the idea of former dryland burial contexts. As outlined in Chapter 5 (Section 5.1.3.2), nine single skeletal elements have been recovered from this stretch of foreshore in the past 20 years, and three have been radiocarbon dated to the Iron Age: one to the Early Iron Age (Putney 1, a subadult mandible), and two to the Middle Iron Age (GEN01 51 an adult male calvarium, and GEN01 4856 a subadult frontal bone) (See Section 6.1.3). Among the four undated elements are post-cranial remains (Putney 3, Putney 5), a maxilla fragment (Putney 4), and a subadult calotte (FWW 03).

Numerous other finds of Iron Age date have been recovered along this Putney/Barn Elms stretch of foreshore for many years, and have raised the question of whether there was a substantial settlement in this area (Cotton, 2017:28). Recent excavations along the foreshore at Barn Elms as part of the Thames Tideway Tunnel have revealed that this is indeed the case, with evidence for a substantial Iron Age settlement (Blanks, 2019). This leads to the question of whether, and how, the Iron Age (and undated but likely Iron Age) human remains from the Putney foreshore could relate to such a settlement. Could they be eroding from former burials along the riverbank? Tentative support for this is given by the calotte FFW 03 (highlighted in Section 6.3.2.1.2) which appears to show evidence for decomposition broadly in-situ, and of not having been fluvially disturbed subsequently.

Again, as previously argued by Bradley and Gordon (1988), and later by Schulting and Bradley (2013) (see Section 3.2.3.1), there is evidence to support the idea that many of the Iron Age Thames individuals could have been intentionally deposited in the river. From the new evidence generated in this thesis, it appears that the deposition of some of the Iron Age human remains from the River Thames could have been linked with martial activities. Such a concept is supported by the male bias observed among the Iron Age individuals, and in the overall assemblage (see Section 7.2.2.2), along with the high prevalence of trauma both in the Iron Age group (64.3%; 9/14 individuals) and the overall assemblage (22.9%; 51/223 individuals affected) (Section 7.6). The overall patterning of the trauma, i.e., potentially indicative of inter-group conflict, also suggests a connection with martial activities (Section 7.7).

The overwhelmingly martial nature of the Bronze Age and Iron Age metalwork recovered from the Thames has been emphasised previously (Needham and Burgess, 1980; Fitzpatrick, 1984; York, 2002), and the new data generated here strengthens the case for a depositional relationship between the two. This takes on particular significance in light of the fact that much of the weaponry, at least that of Bronze Age date (York, 2002; Thorpe, 2013), appears to have been used prior to deposition. One caveat to note, however, is that the recovery of metalwork from the Thames was likely subject to a range of collection biases (e.g., Ehrenberg, 1980; Needham and Burgess, 1980; Fitzpatrick, 1984), in a similar manner to the situation for the human remains (e.g., see Section 6.3.2.1, Section 7.2.2). Items of weaponry, being very distinctive, may have been disproportionately collected.

The observed patterns relating to violence, a male bias, and a martial-dominated metalwork assemblage could have arisen through various depositional scenarios, which will now be considered.

The Iron Age human remains and weaponry recovered from the River Thames are highly consistent with a number of watery sites elsewhere of broadly similar date which have been interpreted in terms of post-battle ritual deposition. One of these is the site of La Téne on Lake Neuchâtel in Switzerland, which has most recently been interpreted as the remains of a trophy which displayed the bodies and equipment of an army defeated in c. 220-200 BC (Lejars, 2013) (see Chapter 2, Section 2.2.1.3). Hundreds of items including vast quantities of weaponry and equestrian equipment were recovered from the lake bed, along with the remains of 50 to 100 people (Fitzpatrick, 2018). Similarly to this analysis of the River Thames assemblage, recent analysis of 16 of the La Téne individuals identified a male bias, and skeletal evidence of violence on a high proportion of individuals (seven) including one instance of decapitation (Alt and Jud, 2007). In relation to the metalwork assemblages, Fitzpatrick (1984:180) has previously emphasised the similarity between the La Téne period metalwork recovered from the River Thames and that of the La Téne site, particularly in terms of the martial and display nature of the finds.

The assemblage of human remains, mostly Late Iron Age in date, dredged from the River Meuse at Kessel in the Netherlands, has also been interpreted as a likely cult place associated with warfare (ter Schegget, 1999). This large assemblage has a very similar level of male bias to that recorded in the River Thames assemblage (75%, 103 individuals, see Table 7.1), numerous remains presented violent trauma, and large

quantities of metalwork and weaponry have also been recovered (ter Schegget, 1999). Many of these had been deliberately damaged or were still in their scabbards, as is the case for much of the River Thames weaponry (e.g., York, 2002; Stead, 2006). Interestingly the patterning of many of the injuries is similar to those encountered in the Thames assemblage; particularly notable among these are small, round perforations noted on both SK 4069 (River Thames, Mortlake, Early Iron Age, see Figure 7.12) and MK166/479 (River Meuse, Late Iron Age, see Figure 10 in ter Schegget, 1999:128).

The presence of subaerial weathering on four of the trauma-affected individuals (SK 4071 from Mortlake, SK 4078 from Mortlake, SK 1490 “Thames”, and SK 1494 “Thames”) is of particular note in light of the display of bodies (e.g., as at La Téne), though could reflect more widespread excarnation practices (e.g., Booth and Brück, 2020) or changing river dynamics after the remains had entered the river system.

The relationship between violence and the deposition of the human remains could of course be more general, and need not involve the display of battle victims. The human remains and weaponry may represent the discarded remnants of battles, as hypothesised for the site of Weltzin 20 on the River Tollense, Germany, which also presented a male bias and skeletal evidence of violence (Jantzen et al., 2011; Brinker et al., 2013; Flohr et al., 2014) (See Chapter 2, Section 2.2.2). But the treatment of the weaponry recovered from the River Thames, with much of it having been damaged (e.g., heated, broken, bent) or deposited within scabbards (e.g., York, 2002; Stead, 2006) suggests a more complex relationship between the human remains and the weaponry. This could be some form of general funerary deposition where people were placed in watery locations along with metalwork of the types that would have been placed in graves (e.g., Bradley, 1998:107): perhaps involving the deposition of warriors with their weapons (e.g., York, 2002; Mörtz, 2018). This may have perhaps been a practice reserved for those individuals involved in violence during their life course, or alternatively some form of water-based deposition could have been a normative mortuary practice for the communities living along the Lower River Thames Valley at this time. In this scenario, the male bias and high prevalence of violence identified here for the River Thames assemblage could instead simply reflect a high level of endemic violence in the region throughout the Iron Age, rather than being directly linked with deposition.

Whatever the exact nature of the relationship, and its temporal development, it appears that the deposition of at least some of the Iron Age human remains in the Thames

assemblage may have been linked with martial activities. The trauma-affected individuals could have been members of local Thames-side communities, perhaps warriors deposited along with their weapons in a form of funerary practice, or defeated “outsiders” whose bodies and weaponry represented the spoils of war (e.g., Wells, 2020:157). In relation to this, it is noteworthy that the sulphur ($\delta^{34}S$) isotope values for two of the trauma-affected Iron Age individuals (SK 1506 and SK 1514; see Table 8.2) were comparatively low, consistent with them having lived locally to the Thames floodplain in the last years of their lives. On the one hand, this could suggest that they were members of the local communities, rather than “outsiders”. On the other hand, the River Thames appears to have been a boundary area during the Iron Age (Wait and Cotton, 2000; Hingley, 2018), and violent conflict in the Iron Age is thought to have been largely small scale, involving groups vying for control of their local communities or of particular resources (Wells, 2020). Thus, isotopically, it is difficult to distinguish between these scenarios.

9.1.3 The Medieval period (c. AD 410-1540)

There were 11 individuals in the Thames assemblage which were of Medieval date (see Section 6.1.2.5). Five of these individuals were radiocarbon dated for the first time in this thesis. Three were articulated skeletons (Bull Wharf 1, Bull Wharf 2, SK 139); and are the earliest examples of such in the River Thames assemblage, with the exception of the Neolithic Yabsley Street inhumation (Yablesy 1, Coles et al., 2008).

Medieval deviant burial practices are important to consider in relation to the deposition of some of these individuals. The term deviant burial is usually applied to burials of a “non-normative” character (Reynolds, 2009:35). As outlined in Chapter 3 (Section 3.1.3.4), the normative burial practice in the broader London area during the Medieval period was for small inhumation, or mixed inhumation and cremation, cemeteries until around the 8th century, by which time Christian burial in consecrated ground was well established. Various motivations for deviant burial have been identified, such as judicial punishment, the disposal of bodies after battle, or superstition; but, in general, they can be thought of as widely understood modes of treating social “others” (Reynolds, 2009). Though traditionally associated with the Early Medieval period (e.g., Geake, 1992), there is evidence for the continuation of such practices throughout the Medieval period in Britain, until the 12th century and potentially in to the 19th century (Reynolds, 2009).

A handful of potentially deviant burials have been identified in the area now covered by central London. These include a prone adult male buried in a shallow grave (radiocarbon dated to cal AD 630-675) at Jubilee Hall near Covent Garden, who was interpreted as an outcast or criminal on the basis of their posture and isolation (Cowie et al., 1988). A double burial at Rangoon Street, London, where two individuals had been "squashed" into the same grave was also interpreted as a deviant burial, though it is undated (Bowler, 1983).

Further examples have been identified from the River Thames foreshore. Two individuals recovered from the former foreshore at Bull Wharf radiocarbon dated cal AD 680-810 (included in this dataset, see Section 6.1.2.5), have previously been interpreted as deviant burials (Ayre and Wroe-Brown, 2015). Burial 1, an adult female, was placed on a bed of reeds with pads of moss placed over their pelvis and knees. They also presented a perimortem cranial injury, which was taken as possible evidence of their murder or execution (Ayre and Wroe-Brown, 2015) (this was not included in the analysis of trauma conducted here, as these individuals belonged to the non-osteological assemblage; see Section 5.1.1). Two other potential examples of Medieval deviant burials have also been tentatively identified from locations close to the River Thames foreshore (not included in this dataset). These are an adult male, radiocarbon dated to cal AD 420-820, buried in a shallow grave at Corney Reach, Chiswick (Lakin, 1996), and a group of 11 individuals buried in a pit near the confluence of the River Fleet and the River Thames (McCann, 1993).

There are various reasons that the River Thames foreshore may have been an appropriate space for deviant burial during this period. In general, deviant burials occupy liminal areas, such as boundaries, in both the earlier and later Medieval periods (Reynolds, 2009). The River Thames acted as boundary throughout the Medieval period: in the earlier parts of the period as a border between the kingdoms of Essex and Kent and Surrey to the south, and later between Mercia and Wessex (Cowie and Blackmore, 2008:133-134, 2012:97-98). By the second half of the 10th century it was a hundred boundary (Ayre and Wroe-Brown, 2015:162).

From the analysis of the River Thames assemblage here, one Medieval individual stands out in particular as potentially associated with deviant burial practice. SK 139, an adult male (genetically determined, see Appendix Table B.1) articulated skeleton recovered close to the River Thames at Millbank in 1929, was provided with a radiocarbon date in this thesis, and returned a date of cal AD 890-985. The skeleton

was reported to have been found at a depth of 13-14 ft, in a layer of muddy blue clay overlying a layer of peat, and to have been lying on their left side in a contracted position with the knees bent at a right angle to the trunk (Tildesley, 1931:182). No grave cut was reported, though evidence for this may have been missed, and no artefacts were found in association with them (Tildesley, 1931).

The circumstances of their burial do not obviously reflect a Christian burial, which was the established practice in London at this point. Although no grave was reported, it is perhaps likely that they were deliberately buried, owing to the lack of evidence for subaerial exposure (as determined in this thesis, see Section 6.3.1.3.2) and their contracted position. A contracted burial position has often been interpreted as a feature of deviant burials in Medieval Britain (Hirst, 1985:36); however, it has also been argued that this is simply a variant on supine burial (Lucy, 2000:80-81), so it is not considered a reliable indicator of deviant burial (Reynolds, 2009:63). However, this individual is consistent with features of isolated deviant burial, as defined by Reynolds (2009:209): namely a boundary location, and lack of grave furnishing, suggesting outcast status. This is only one possible depositional scenario for this individual, and without additional contextual information it remains speculative.

The isotopic data presented in Chapter 8 could give additional insight, as social status-based differences in isotope values have been identified in Early Medieval cemetery contexts (e.g., Schutkowski et al., 1999; Privat et al., 2002). It might be expected that individuals buried in a deviant manner were in some way of lower social status (e.g., Reynolds, 2009). Privat et al., (2002) found statistically significant status-based differences in $\delta^{15}N$ values at the Early Medieval (5th to early 7th centuries AD) cemetery of Berinsfield on the Upper Thames near Oxford. The “poor” group had elevated $\delta^{15}N$ values (mean 10.2‰) compared to the “wealthy” group (mean 9.5‰), which the authors consider may be due to the increased consumption of aquatic foods or omnivore protein among the “poor” individuals (Privat et al., 2002). Interestingly, SK 139 had the second lowest $\delta^{15}N$ value among the overall dataset at 9.1‰ (see Table 8.2). If compared with the Berinsfield data this would actually suggest an elevated social status for SK 139, rather than lower. Nonetheless, it should be emphasised that a multitude of factors, both social and otherwise, intersect to influence the diet and nitrogen isotope values of an individual (Müldner, 2009).

From the River Thames assemblage, there are additionally a number of single skeletal elements of Medieval date which may be of relevance to the idea of deviant burial.

GEN01 31, an adult male cranium from Kew radiocarbon dated to cal AD 890-1030 (see Section 6.1.2.5) presented five perimortem sharp force injuries to the left side of their cranium (Figure 7.16). These injuries may have been sustained in a battle, massacre, or execution context: possible motivating factors for deviant burial in the Medieval period (Reynolds, 2009). Mutilation and decapitation are also commonly-associated with deviant burial practices (e.g., Buckberry and Hadley, 2007; Reynolds, 2009). In this respect, it would be of particular interest in further work to provide radiocarbon dates for GEN01 55, the undated male mandible recovered from Barn Elms with evidence of decapitation (see Section 7.6.2.2.5, Figure 7.17) and GEN01 80, the undated cranium from Wandsworth which presented potential evidence of bodily mutilation (see Section 7.6.2.2.5, Figure 7.18).

Lastly, although this section has focused on the concept of deviant burial, and how it may account for the deposition of some of the Medieval individuals, it is important to emphasise that, as in all time periods, there are any number of possible depositional circumstances (e.g., bodies entering the river through accidental drowning).

9.1.4 The Post-Medieval period (c. AD 1540-1901)

Nine individuals in the Thames assemblage have been dated to the Post-Medieval period, five of which were identified in the new programme of radiocarbon dating (Table 6.8). A high proportion of these, five individuals, were represented by articulated skeletons. Four of these are known to have been recovered from the present-day foreshore, or the former foreshore surface in the central and more eastern stretches of the river. Two of these foreshore individuals were recovered from Chambers Wharf, Bermondsey: Chambers 1 (MOLAHeadland, 2018), and Chambers 2 (Bayliss et al., 2004). The other two were recovered from the Isle of Dogs: Burrells 1 from Burrells Wharf (Cohen et al., 2013) and CC188 1 from Cyclops Wharf (Williams, 1988). It is suspected that SK 4178, from Greenwich and also an articulated skeleton, was also recovered from the foreshore though this information is not provided in the associated collection documentation.

There is no evidence for the intentional burial (i.e., a grave cut) of any of these articulated skeletons. In most cases this is owing to a lack of information, but in the cases of Chambers 1 and CC188 1 this is specifically stated (Williams, 1988; MOLAHeadland, 2018). Chambers 1, recovered during archaeological excavations for the Thames Tideway Project appears to have been washed up on the former foreshore

surface, where they decomposed in-situ (MOLAHeadland, 2018), and a similar conclusion was reached for CC188 1 (Williams, 1988). The rodent gnawing and weathering observed on SK 4178 (see Section 6.3.1) indicates that they were sub-aerially exposed and not formally buried, at least for a prolonged period.

It appears that at least two of these individuals (Chambers 1 and CC188 1), and potentially some of the other Post-Medieval individuals, could represent the non-recovery of bodies washed up on the Thames foreshore. The diary of Samuel Pepys (1633-1703) provides a first-hand account of such a scenario. On the 4th April, 1663 he wrote: "I was much troubled today to see a dead man, he floating upon the water, and had done, they say, these four days, and nobody takes upon to bury him, which is very barbarous" (cited in Hume, 1956:179). The circumstances surrounding the deaths of these individuals, of course, cannot be known: perhaps having drowned in the river as the result of accident or suicide, or meeting their deaths before entering the water.

9.2 The Maynard Reservoir assemblage

This section will consider aspects of the deposition of the Maynard Reservoir assemblage, drawing on the results and discussion presented in Chapters 5-8, and also the wider archaeological context.

9.2.1 A violent episode in a wetland community?

On the basis of the three instances of perimortem trauma, which appear to have been sustained in a face-to-face attack (see Section 7.9), one possibility to consider is whether the Maynard Reservoir assemblage could represent the victims of a single violent episode during the Late Bronze Age within a wetland community. Although direct skeletal evidence for violence is rare in Late Bronze Age British contexts (see Section 7.9.2), this is in part owing to the nature of the burial record. Several lines of evidence suggest the presence of small scale inter-community warfare in Bronze Age Europe, and that this may have been on the rise during the Late Bronze Age (e.g., Thorpe, 2013).

The demographic profile (i.e., broadly catastrophic) of the Maynard Reservoir assemblage (see Section 7.4) and the involvement of at least one female (SK 4191) and an adolescent individual (SK 4200A) in violence, is somewhat at odds with general patterns identified for later prehistoric Europe, where conflict mortality profiles and

skeletal evidence of violence are largely biased towards young adult males (e.g., Redfern and Chamberlain, 2011). Yet, there is some evidence to suggest that non-combatants were sometimes targeted in prehistoric warfare (e.g., Bishop and Knüsel, 2005). Massacre events in particular may have affected all age groups and sexes (e.g., Willey and Emerson, 1993).

The incorporation of the fleshed bodies or body parts into the marshy areas or palaeochannels of the River Lea (as suggested by the combined taphonomic evidence and context information, see Section 6.4.2) could reflect the disposal of bodies after a violent event, and the denial of normative Late Bronze Age burial practices, which rendered most individuals archaeologically invisible (e.g., Brück, 1995). A similar interpretation has been made elsewhere, as an explanation for a group of five Late Bronze Age young adult males recovered from a ditch in Tormarton, Gloucestershire, two of which presented perimortem spear injuries (Osgood, 2006).

This interpretation for the Maynard Reservoir assemblage, of deposition involving a single violent event, would require further support in the future from extended radiocarbon dating evidence, since the three current radiocarbon dates for the Maynard Reservoir assemblage do not present a high degree of congruence (see Section 6.1.4).

9.2.2 Ritual deposition in water?

The Maynard Reservoir assemblage does share several similarities with other assemblages of Late Bronze Age date which have been recovered from watery contexts, and which have been interpreted as evidencing a relationship between watery environments and ritual practices. Particularly notable among these are the association of the human remains with a form of wooden structure (e.g., Wilkinson and Murphy, 1995; Brunning, 1997; Allen et al., 2000; Pryor, 2001), and the association of the human remains with an animal bone and artefactual assemblage (e.g., Brunning, 1997; Allen et al., 2000; Pryor, 2001).

The Flag Fen basin in Cambridgeshire (Pryor, 2001), interpreted as a major site of ritual deposition in the Late Bronze and Iron Age (see Section 2.2.1.3), provides a particularly close parallel with the evidence from the Maynard Reservoir. Here a relatively small number of human skeletal remains of probable Late Bronze Age date were recovered in the vicinity of both the Fengate Power Station timber post alignment (MNI of seven), which has been dated to between 1300 and 900 BC, and the Flag Fen

platform itself (MNI of two) (Halstead and Cameron, 1992; Halstead et al., 2001; Pryor, 2001). In-keeping with the evidence from Maynard Reservoir, some paired elements were present among the human remains, subadult remains were present, and there was some evidence for animal gnawing (Halstead and Cameron, 1992; Halstead et al., 2001). A range of animal bones were also recovered in close proximity to the human remains, including both wild and domestic species (Halstead and Cameron, 1992; Halstead et al., 2001). The significant artefactual assemblage recovered from the Flag Fen sites shows several parallels with that associated with the Maynard Reservoir assemblage (see Table 5.5). These include the presence of complete ceramic vessels, and metalwork; much of which was of Iron Age date (Pryor, 2001). The recovery of two Middle Iron Age cauldron bases from the Maynard Reservoir site (see Table 5.5 and Figure 5.9) is particularly noteworthy: owing to their role in feasting activities it has been considered that they may represent “socially-charged” objects in the Iron Age, likely to be selected for special deposition; for example in hoards and watery contexts (Joy, 2014; Giles, 2020).

Notably, several human bones of probable Late Bronze Age date were also encountered in palaeochannels of the River Lea at the site of Innova Park (McKinley, 2005; Ritchie et al., 2008), around 10 km further upstream of the Maynard Reservoir. As at the Maynard Reservoir these included cranial and post-cranial remains (one calvarium, one mandible, one humerus and one femur) (McKinley, 2005). A small quantity of human bone was also recovered from a “midden-like” deposit at the base of a Late Bronze Age wooden river channel revetment (Ritchie et al., 2008:14). The presence of these bones led Ritchie (2008:18) to suggest that a small four-post wooden structure situated along the bank of a palaeochannel may have been used as an excarnation platform. The presence of these human remains raises the question of whether the Maynard Reservoir may have been part of wider local traditions involving the deposition of human remains in marshy/river channel environments along the River Lea during the Late Bronze Age.

9.3 Limitations

There are numerous limiting factors associated with examining the deposition of the River Thames and Maynard Reservoir assemblages, many of which have already been discussed at length in the preceding chapters. Perhaps the most significant among these is the lack of contextual information for the majority of the River Thames assemblage, which predominantly reflects the fact that most of the assemblage was

recovered through historical dredging (see Chapter 5). In this case, the key pieces of contextual data which are missing are the lack of date, poor spatial information (see Section 5.1.2.1 for discussion), and the lack of information about the deposits from which the individuals were recovered. Additionally, although this thesis has significantly increased the number of dated individuals, the temporal data is still somewhat limited. As such, the sample sizes available for each time period are small (maximum n=16), and this limits the strength of conclusions which can be drawn regarding deposition practices, which would have likely varied significantly through time.

Other significant limiting factors include a number of recovery biases, which have been considered in the previous chapters: in relation to the over-representation of crania (Section 6.3.2.1), the male bias (Section 7.2.2), and the under-representation of subadults (Section 7.2.3). In general, the recovery biases combine to limit the extent to which one can assume that the assemblage as recovered is reflective of the "true" assemblage as deposited. Potential methodological issues also existed in relation to the bias towards males (Section 7.2.2), and the high prevalence of violence-related trauma in the assemblage (Section 7.7.3), but these were not considered to be significant limiting factors.

Chapter 10 Conclusions

At the outset of this thesis, it was known that a great number of human remains, predominantly crania, had been recovered from the Lower River Thames over the centuries; predominantly through historical dredging and antiquarian collecting activities in the late 19th and early 20th centuries. These human remains, many of which reside in the collections of the Natural History Museum, London, and the Museum of London, had attracted considerable scholarly attention, which had focused largely on debating their depositional origins.

Broadly, two lines of thought had emerged through this previous scholarship. One viewed the remains as evidence for the selective deposition of crania directly into the river, or in wet places alongside it, as part of later prehistoric funerary practices associated with the votive deposition of weaponry (Bradley and Gordon, 1988; Bradley, 1995; West, 1996; Schulting and Bradley, 2013). The other argued for the importance of the action of fluvial processes through time in the formation of the assemblage, with the remains likely to represent the erosion of riverside burials and the bodies of drowning victims (Knüsel and Carr, 1995, 1996).

While mindful of this previous scholarship, the broad aims of this thesis were to move beyond the debates as previously configured and to utilise multiple new lines of evidence (radiocarbon, taphonomic, osteological, and isotopic data) to provide the most comprehensive study of the Thames assemblage and its deposition to-date (see Section 1.2). The Maynard Reservoir assemblage, recovered during construction works in the 1860s along the course of the River Lea (a tributary of the River Thames) was also examined, as it represented a smaller, but better contextualised assemblage of human remains, some of which were known to be of Late Bronze Age date (Schulting and Bradley, 2013).

The rest of this chapter will summarise the main findings for Thames assemblage, followed by the Maynard Reservoir assemblage. Finally, recommendations will be made for potential areas of future work involving the River Thames and Maynard Reservoir assemblages.

10.1 The River Thames assemblage

The study assemblages were defined and described in Chapter 5. The River Thames assemblage, as generated for the purposes of this thesis, comprised 237 human remains which had been recovered from the Lower River Thames. The vast majority of these were likely recovered through historical dredging practices (80.6%; 191/237), though efforts were made to incorporate as many human remains recovered from the present-day foreshore as possible (a total of 21 individuals), as the latter typically had more secure contextual information and provided an important comparison sample for the dredged remains.

An enhanced understanding of the temporal patterning in the Thames assemblage was developed in Chapter 6. A series of 31 new radiocarbon dates were generated for the River Thames assemblage, and these were combined with existing dates to produce an overall temporal dataset, with the effect that 26.2% (62/237) of the individuals in the River Thames assemblage now have associated dates. This dataset presented a bias towards individuals of Bronze Age, particularly Late Bronze Age, and Iron Age date. Furthermore, on the basis of the spatial patterning in the temporal dataset, a significant proportion of the remaining undated individuals in the River Thames assemblage (175 individuals) are expected to be of similar Late Bronze or Iron Age date. This finding broadly supports the previous observations of Schulting and Bradley (2013), and is contra to Knüsel and Carr (1995) who hypothesised that (although with a much smaller available dated sample) there was no evidence for such a temporal bias and the remaining undated individuals could have belonged to any time period (see Section 3.2.3.1).

The taphonomic histories of the River Thames assemblage were also examined in Chapter 6. A dominance of single cranial elements was recorded in the assemblage, which was consistent with the findings of previous studies (Bradley and Gordon, 1988; Knüsel and Carr, 1995; Schulting and Bradley, 2013). These previous studies had placed considerable interpretative significance on this finding (see Section 3.2.3.1), but it was deemed to be of limited interpretative significance in this thesis. In part, this is owing to the likelihood of recovery bias, the extent of which is demonstrated by the element composition of the present-day foreshore finds. The taphonomic modifications observed on the bones themselves raised the possibility that many of the elements could have been fluvially transported at some point in their depositional history. However, as argued at the end of Section 3.2.3.1, evidence for fluvial transport doesn’t

preclude the human remains from entering the river under any particular circumstances. A small portion of the assemblage, including elements of Bronze Age date, presented evidence for surface exposure at some point in their depositional history, whether prior or subsequent to their initial entry into the river deposits.

In Chapter 7, the demographic profile of the River Thames assemblage was examined, along with evidence for violence-related trauma. The demographic analysis identified a male bias among the adults in the overall assemblage: of individuals assigned a specific sex, males represented 72% (111/155) and females only 28% (44/155). Genetic sex estimates, recently generated for 32 of the Thames individuals (Booth, 2019; Green et al., 2019), were utilised to assess the potential contribution of methodological issues to the male bias. It was concluded that the osteologically-identified male bias in the overall Thames assemblage was not obviously produced by methodological limitations. Subadults were under represented in the assemblage, though post-depositional factors may have been responsible for this. Again, consideration of the individuals recovered from the present day foreshore was illuminating in this regard. The demographic profile of the River Thames assemblage presented here was largely consistent with those reported previously for different subsets of the assemblage (Bradley and Gordon, 1988; Knüsel and Carr, 1995, see Table 7.1), though in the current study the proportion of subadult to adult remains was higher, and the male bias more pronounced.

A high prevalence of violence-related trauma was identified for the River Thames assemblage, with 22.9% (51/223) of individuals affected. This was considerably higher than the 14.0% (21/150 individuals) previously reported for a subset of the assemblage (Schulting and Bradley, 2013). The Iron Age was identified as having a particularly high trauma prevalence with 64.3% (9/14) of individuals affected, and trauma-affected individuals dating to the Late Bronze Age were identified for the first time. Many of the trauma-affected individuals were males who appear to have been engaged in face-to-face violence. It was considered likely that the majority of the remaining undated trauma-affected individuals are of Iron Age, or potentially Late Bronze Age date.

A stable carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$) and sulphur ($\delta^{34}S$) isotope analysis of 42 individuals from the River Thames (n=40) and Maynard Reservoir (n=2) assemblages was provided in Chapter 8, to examine aspects of diet. The data indicated diets based on terrestrial C_3 resources for individuals from all time periods, with a degree of marine resource consumption for individuals in the later, Roman, Medieval, and Post-Medieval

periods. The prehistoric individuals were found to have unusual, highly depleted $\delta^{34}S$ values, which are among the lowest found in any Holocene European context to-date. These low values are considered likely to have arisen through processes of flooding and waterlogging which may have depleted the bioavailable $\delta^{34}S$ values of grazing land on the Thames floodplain. This suggested that many of the prehistoric individuals likely lived locally to the immediate River Thames, and River Lea floodplain areas, at least in the later years of their life.

Chapter 9 drew on aspects of the results and discussion presented separately in the preceding chapters (5-8) to consider deposition for specific time periods within the River Thames assemblage. For the Bronze Age, particularly the Late Bronze Age, and Iron Age individuals, it was considered unlikely that the majority could have derived from dryland contexts, although this is certainly a possibility in some instances. Instead, the evidence may support ideas of ritual deposition in the river or the immediate surroundings. For the Iron Age, and potentially also the Late Bronze Age, a depositional relationship with martial activities was proposed on the basis of the observed male bias and prevalence and patterns of trauma, in combination with previous observations regarding the River Thames metalwork assemblage. Various depositional scenarios were given thought to, including forms of ritual post-battle deposition, and the deposition of warriors along with their weapons in a form of funerary practice. Moving forward through time, deviant burial practices and the non-burial of bodies were considered in relation to the Medieval and Post-Medieval individuals.

10.2 The Maynard Reservoir assemblage

In Chapter 5 it was demonstrated that the Maynard Reservoir assemblage were likely recovered in the vicinity of a large wooden structure, which was called a “cranoge” at the time of discovery, though it is unclear what the structure actually represented (see Figure 5.8). Labelling on some of the human remains indicated that they were recovered from shell marl, with bones of wolf, beaver, red deer and goat. Various artefacts, many of them Iron Age in date, were also reported to have been recovered in association with this wooden structure (outlined in Table 5.5).

A total of three radiocarbon dates have been provided for the Maynard Reservoir assemblage, each representing a separate individual (Chapter 6, Section 6.1.4). All three individuals were of Late Bronze Age date; however there were only 55 years of

overlap, between 1110 and 1055 cal BC, between the two crania (SK 4191 and SK 3311). On the basis of the current dating evidence it is therefore unclear whether the assemblage could have been formed by a single, or multiple, depositional episodes.

Investigation into the taphonomic histories of the assemblage in Chapter 6 identified that it comprised the cranial and post-cranial remains of at least eight adults and four subadults. Five articulated elements were present, and there was evidence for a prolonged period of subaerial exposure. It was hypothesised on the basis of the taphonomic data, combined with the environmental context, that the assemblage likely formed through the excarnation and decomposition of bodies in an open environment: either in, or in the marshy areas around, the slow-moving palaeochannels of the River Lea.

In Chapter 7, the demographic analysis of the assemblage revealed the presence of subadults of a range of ages: at least one individual aged between three to four years old, one aged around seven years old, and one adolescent. Among the adult elements, males and females were present in approximately equal proportions. It was argued that the demographic profile could represent a catastrophic mortality profile, being close to the expected demographic structure of a living, small, later prehistoric community.

Perimortem trauma was identified on three elements in the Maynard Reservoir assemblage in Chapter 7: SK 4191, an adult, genetic female, cranium (radiocarbon dated to 1220-1055 cal BC); SK 3311, an adult cranium of indeterminate sex (radiocarbon dated to 1110-900 cal BC); and SK 4200A, an undated adolescent humerus. The nature of the injuries suggested the involvement of these individuals in violent face-to-face encounters around the time of their deaths, and provides rare evidence for Late Bronze Age skeletal trauma in a British context.

SK 4191 and SK 3311 were included in the isotopic analysis in Chapter 8, in which their results were consistent with the broader Bronze Age group (e.g., see Table 8.2). This suggests a diet based largely on terrestrial C_3 resources. Their low $\delta^{34}S$ values, -4.0‰ and -12.8‰ respectively, potentially indicate the consumption of food sources influenced by a freshwater ecosystem (e.g., cattle grazed on the floodplain), and suggest that, at least in the last years of their lives, these individuals were likely to have lived locally to the River Lea.

Chapter 9 drew on strands of the results and discussion presented separately in the preceding chapters (5-8), and considered the assemblage in its wider archaeological context, in order to consider different depositional scenarios for the Maynard Reservoir assemblage. The current evidence suggests that it may be appropriate to link the assemblage with wider practices of ritual deposition in watery places. The associated artefacts suggest that such deposition could have occurred from the Bronze Age through to the Iron Age, as has been identified at other sites (e.g., Pryor, 2001).

10.3 Future work

As described in Section 9.3, one of the major limiting factors to interpreting the deposition of the River Thames and Maynard Reservoir assemblages is the lack of associated contextual information for the human remains; foremost among these is the lack of temporal data, with 73.8% (175/237) of the assemblage currently undated. Only direct, radiocarbon dating is able to provide this information for the majority of individuals. Even if stratigraphic contextual information were available for the remains (which it is not for the majority) it would not be possible to assign relative dates to the single skeletal elements, owing to the fact that they may have been re-deposited from their original depositional context by the action of the river.

For the River Thames assemblage it is recommended that future radiocarbon dating efforts should focus on the remaining undated individuals with evidence of violence-related trauma (33 individuals). It was hypothesised that the majority of these individuals are likely to be of Iron Age and possibly also Late Bronze Age date (see Section 7.7.1), and this was drawn upon to support the idea of a relationship between the deposition of many of the Iron Age individuals and martial activities in Chapter 9. Further radiocarbon dating of the trauma-affected individuals has the potential to assist with strengthening this interpretation, and would also allow for consideration of whether this is predominantly an Iron Age pattern, or one which is also present in the Late Bronze Age. It would also allow for an investigation of how trauma patterns may have changed through time, from the Neolithic to the Post-Medieval periods; potentially also revealing new insight into deposition in these time periods. For instance, it would be of particular interest to resolve whether the undated individuals with evidence of decapitation (GEN01 55) and mutilation (GEN01 80) are of prehistoric or medieval date.

For the Maynard Reservoir assemblage, further radiocarbon dating of the human remains has the potential to assist with strengthening interpretations of deposition. Currently, radiocarbon dates only exist for three of the 33 elements, and while these are all Late Bronze Age in date, there were only 55 years of overlap between the two trauma-affected crania (SK 4191 and SK 3311) (Section 6.1.4). It is therefore currently unclear whether the assemblage could have been formed in a single depositional episode, such as a violent event, or over multiple depositional episodes. Although useful, further radiocarbon dating may not be able to definitively resolve this question, particularly in light of the evidence for the curation of human remains in the Late Bronze Age (e.g., McKinley, 2017; Booth and Brück, 2020). Genetic kinship relationships could be an illuminating area of future research (e.g., Ensor, 2021), in particular the identification of kinship relationships between the trauma-affected individuals (e.g., could they belong to different generations of the same family?).

The continued analysis of present day foreshore finds would be beneficial to enhancing current understandings of the deposition of the River Thames assemblage. As demonstrated throughout this thesis, they provide a useful lens through which to view the effects of recovery bias on the composition of the assemblage, and can help to develop a more nuanced picture of deposition. Accompanying contextual information, which is sometimes recorded by the finders, also has the potential to be particularly valuable. An example of this was provided by GEN01 59, the trepanned individual recovered from the submerged Neolithic forest bed on the Chelsea foreshore.

Future publication of the archaeological works taking place along the course of the River Thames (e.g., the Thames Tideway Tunnel activities at Barn Elms (Blanks, 2019)) may provide an enhanced context through which to interpret particular subsets of the River Thames assemblage. As outlined in Chapter 2, modern archaeological excavations along the course of the Walbrook Stream, a River Thames tributary, revealed evidence for the erosion of a Roman period cemetery on the riverbank (Harward et al., 2015). This finding had significant implications for previous interpretations of the Walbrook crania, which had focused on ideas of the ritual deposition of crania in water (Marsh and West, 1981).

10.4 Final remarks

The River Thames assemblage has been formed through the incorporation of a great number of human remains into the river and its deposits, from at least the Neolithic to the Post-Medieval periods. This thesis has confirmed that overall, there is a particular bias towards human remains of Late Bronze and Iron Age dates.

A variety of different depositional practices and processes are likely to have formed the River Thames assemblage, acting both across and within time periods. A number of limitations associated with the assemblage (e.g., a lack of contextual information) mean it is difficult to interpret deposition with a high level of confidence. Nevertheless, a number of broad themes have emerged. There is some evidence to support the deposition of human remains in the river and its deposits in ritual contexts in different time periods, including in the Late Bronze Age and Iron Age as originally hypothesised by Bradley and Gordon (1988) and again by Schulting and Bradley (2013). The findings of this thesis suggest that deposition of human remains in these periods may be linked in some way with martial activity, an interpretation which future radiocarbon dating work could further strengthen. The overall findings of this work are largely contrary to Knüsel and Carr (1995) who argued that the majority of the River Thames assemblage was likely to have arisen via the erosion of riverside burials and as the bodies of drowning victims, accumulating through time. However, such processes represent potential contributing factors in all time periods, as highlighted by some of the Post-Medieval evidence.

This thesis has provided a comprehensive examination of the River Thames and Maynard Reservoir assemblages and their deposition. Through doing so it has contributed to understandings of the people living along the Lower Thames through almost 6000 years of time from the Neolithic to Post-Medieval periods. This includes new insight into their potential funerary practices, and also their lifeways more generally in terms of their diet, utilisation of the floodplain environment, and exposure to violence. This information takes on particular significance for prehistoric London, for which comparatively little has been known about human activities (e.g., Sidell, 2001).

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Appendix A The temporal dataset

Appendix Table A.1: Full radiocarbon data for the River Thames assemblage and Maynard Reservoir assemblage temporal datasets. The radiocarbon dates generated specifically for the current project are indicated by GrM lab codes and source of date as “Arthur”. Unless otherwise specified in the “Note” column, all single conventional radiocarbon ages (^{14}C yr BP) or fractionation-corrected fraction modern (F^{14}C) values have been calibrated using the IntCAL20 atmospheric calibration curve (Reimer et al., 2020) and OxCAL v4.4.1 (Bronk Ramsey, 2009). Calibrated date ranges are quoted at the 95% confidence level. Following the recommendations of Mook (1986) and Bayliss et al. (2008), the end points of the calibrated date ranges have been rounded outwards to five years, unless the error is greater than ±25 years in which case they have been rounded out to ten years.

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	F^{14}C	cal BC/AD (95% confidence)		%C	%N	C:N	δ^{13}C	δ^{15}N	Source of date	Note
Yabsley 1*	Yabsley Street	Burial context (skeleton)	KIA20157	5252 ±28	X	-4230	-3980	X	X	X	–22.39±0.17	x	Coles et al., 2008	RC date for burial is from oak plank in grave
SK 1515	Battersea Bridge	Cranium	OxA-1199	4880 ±80	X	-3950	-3380	X	X	X	X	X	Bradley & Gordon 1988	X
2019.8	Putney	Frontal bone	SUERC-82512	X	0.5507±0.0015	-3640	-3520	X	X	3.3	-21.30	10.60	Unpublished. Dated by police. Remains and radiocarbon report curated at MOL.	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	F^{14}C	cal BC/AD (95% confidence)		%C	%N	C:N	δ^{13}C	δ^{15}N	Source of date	Note
SK 19	Crossness	Calvarium	GrM-16893	4795 ±25	0.5506±0.0018	-3640	-3525	44.2	15.2	3.4	-20.91±0.05	10.26±0.10	Bradley & Gordon 1988	X
FKN01 Femur1*	Chelsea	Left femur	OxA-20589	4243 ±30	X	-2920	-2700	X	X	3.4	-22.00	9.20	Unpublished. Dated by Historic England/TDP.	X
SK 4162	Northfleet	Calvarium	GrM-16906	4115 ±20	0.5992±0.0015	-2860	-2575	44.1	15.7	3.3	-22.25±0.17	10.45±0.10	Arthur	X
GEN01 52	Syon Reach	Calvarium	OxA-14728	3819 ±33	X	-2460	-2140	X	X	3.3	-21.20	10.80	Edwards et al., 2009	X
GEN01 27	Mortlake	Cranium	OxA-14731	3485 ±33	X	-1900	-1690	X	X	3.3	-21.00	10.80	Edwards et al., 2009	X
GEN01 59	Chelsea	Calotte	OxA-11087	3412 ±40	X	-1880	-1560	X	X	X	-20.4	11.5	Edwards et al., 2009	X
			OxA-11086	3373 ±39	X	-1750	-1530	X	X	X	-20.3	11.3		
FKN01 Femur2*	Chelsea	Left femur	OxA-20511	3253 ±30	X	-1620	-1440	X	X	3.3	-20.50	10.20	Unpublished. Dated by Historic England/TDP.	X
SK 4167	Battersea	Calvarium	GrM-16891	3040 ±20	0.6851±0.0019	-1395	-1220	43.6	15.6	3.3	-20.81±0.05	10.43±0.10	Arthur	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	F^{14}C	cal BC/AD (95% confidence)		%C	%N	C:N	δ^{13}C	δ^{15}N	Source of date	Note
SK 1521	Battersea/Vauxhall Bridge	Cranium	OxA-1198	2950 ±60	X	-1390	-990	X	X	X	X	X	Bradley & Gordon 1988	X
SK 4191A	Maynard Reservoir	Mandible	OxA-18774	2979 ±30	X	-1380	-1050	X	X	X	-20.40	X	Schulting & Bradley 2013	X
SK 1522	Battersea	Cranium	GrM-16904	2985 ±20	0.6898±0.0019	-1280	-1120	43.8	15.7	3.3	-20.34±0.05	9.79±0.10	Arthur	X
SK 4105	Mortlake	Mandible	GrM-16903	2980 ±20	0.6900±0.0017	-1275	-1120	44.2	15.6	3.3	-20.46±0.05	10.52±0.10	Arthur	X
GEN0129	Mortlake	Cranium	OxA-14765	2904 ±33	X	-1220	-1000	X	X	3.2	-20.60	10.50	Edwards et al., 2009	X
SK 4191	Maynard Reservoir	Cranium	GrM-16907	2940 ±20	0.6900±0.0019	-1220	-1055	43.9	15.8	3.2	-20.81±0.17	10.49±.10	Arthur	X
SK 4062	Kew	Cranium	GrM-16998	2920 ±25	0.6953±0.0022	-1215	-1015	44.0	15.8	3.2	-20.94±0.20	10.02±0.10	Arthur	X
			OxA-1197	2910 ±60	X	-1280	-920	X	X	X	X	X	Bradley & Gordon 1988	X
UNREG 1414	Battersea	Cranium	GrM-16838	2905 ±20	0.6963±0.0015	-1200	-1010	44.4	16.3	3.2	-20.66±0.05	10.17±0.10	Arthur	X
SK 4067	Kew	Cranium	GrM-16911	2895 ±20	0.6973±0.0016	-1195	-1005	43.4	15.5	3.3	-20.15±0.17	10.54±0.10	Arthur	X
SK 4070	Mortlake	Calvarium	OxA-1196	2750 ±80	X	-1120	-790	X	X	X	X	X	Bradley & Gordon 1988	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	$F^{14}C$	cal BC/AD (95% confidence)		%C	%N	C:N	$\delta^{13}C$	$\delta^{15}N$	Source of date	Note
SK 3311	Maynard Reservoir	Cranium	OxA-18773	2825 ±29	X	-1110	-900	X	X	X	-20.30	X	Schulting & Bradley 2013	X
SK 1507	Mortlake Reach	Cranium	GrM-16851	2795 ±20	0.706±0.0016	-1015	-860	43.6	15.7	3.2	-19.64±0.05	9.82±0.10	Arthur	X
			OxA-1195	2740 ±60	X	-1050	-790	X	X	X	X	X	Bradley & Gordon 1988	X
SK 4084	Mortlake	Calotte	GrM-16909	2760 ±20	0.7092±0.0017	-980	-830	43.8	15.6	3.3	-20.34±0.17	11.81±0.10	Arthur	X
SK 4073	Mortlake	Calvarium	GrM-16850	2750 ±20	0.7101±0.0018	-970	-825	43.5	15.8	3.2	-19.88±0.05	10.72±0.10	Arthur	X
SK 1520	Battersea Bridge	Cranium	OxA-18775	2477 ±29	X	-770	-420	X	X	X	-19.90	X	Schulting & Bradley 2013	X
SK 1529	Thames	Cranium	OxA-18777	2468 ±29	X	-770	-420	X	X	X	-20.20	X	Schulting & Bradley 2013	X
SK 1516	Battersea Bridge	Cranium	GrM-16899	2460 ±20	0.736±0.0016	-755	-420	43.6	15.7	3.2	-20.14±0.05	11.01±.10	Arthur	X
SK 4069	Mortlake	Cranium	OxA-18778	2415 ±29	X	-750	-400	X	X	X	-20.20	X	Schulting & Bradley 2013	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	$F^{14}C$	cal BC/AD (95% confidence)		%C	%N	C:N	$\delta^{13}C$	$\delta^{15}N$	Source of date	Note
Putney 1*	Putney	Mandible	SUERC-82794	X	0.7398±0.0023	-750	-400	X	X	3.6	-21.70	9.80	Unpublished. Dated by police. Remains with London PAS.	X
SK 1506	Mortlake Reach	Calvarium	GrM-16905	2420 ±20	0.7398±0.0018	-730	-405	44.0	15.8	3.3	-20.28±0.17	11.14±0.10	Arthur	X
SK 4092	Mortlake	Mandible	GrM-16898	2375 ±20	0.7443±0.0021	-520	-390	44.0	15.6	3.3	-20.80±0.05	11.39±0.10	Arthur	X
SK 4168	Battersea	Calotte	OxA-18776	2289 ±28	X	-410	-210	X	X	X	-19.90	X	Schulting & Bradley 2013	X
SK 1514	Chelsea Bridge	Cranium	GrM-16846	2285 ±20	0.7523±0.0017	-400	-230	43.3	15.7	3.2	-20.02±0.05	8.67±0.10	Arthur	X
GEN01 4856	Putney	Frontal bone	SUERC-54048	X	0.7548±0.0029	-400	-200	X	X	3.3	-21.00	11.70	Unpublished. Dated by police. Remains and radiocarbon report curated at MOL.	X
SK 4074	Mortlake	Calvarium	OxA-18779	2270 ±28	X	-400	-200	X	X	X	-20.20	X	Schulting & Bradley 2013	X
GEN01 51	Putney	Calotte	OxA-14730	2232 ±29	X	-390	-200	X	X	3.3	-20.50	11.90	Edwards et al., 2009	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	F^{14}C	cal BC/AD (95% confidence)		%C	%N	C:N	δ^{13}C	δ^{15}N	Source of date	Note
SK 1526	Northfleet	Mandible (maxilla)	GrM-16841	2050 ±20	0.7748±0.0019	-150	25	43.8	15.9	3.2	-19.77±0.05	11.80±0.10	Arthur	X
SK 4055	Kew	Cranium	GrM-16997	2045 ±25	0.7752±0.0024	-150	55	43.4	15.6	3.3	-20.91±0.20	12.09±0.10	Arthur	X
SK 1558	Waterloo	Cranium	GrM-16843	2015 ±20	0.7781±0.0019	-50	65	44.0	16.0	3.2	-19.99±0.05	11.46±0.10	Arthur	X
SK 4120	Wandsworth	Calvarium	OxA-18780	1961 ±28	X	-40	130	X	X	X	-20.00	X	Schulting & Bradley 2013	X
SK 4130	Robiamors Dry Dock, Limehouse	Cranium	GrM-16894	1935 ±20	0.7857±0.0018	20	205	43.9	15.7	3.3	-18.78±0.05	11.14±0.10	Arthur	X
SK 1518	Battersea Bridge	Cranium	GrM-16849	1915 ±20	0.7877±0.0018	65	210	42.8	15.6	3.2	-19.62±0.05	8.94±0.10	Arthur	X
SK 4137	Deptford	Calvarium	GrM-16890	1895 ±20	0.7897±0.0018	80	215	44.1	15.7	3.3	-19.19±0.05	12.89±0.10	Arthur	X
Putney 2*	Putney	Mandible	X	X	X	X	X	X	X	X	X	X	Unpublished, documentation unavailable. See notes.	Radiocarbon date reported as 'Roman' but documentation not available
UNREG 6828	Battersea	Cranium	OxA-1191	1320 ±60	X	600	880	X	X	X	X	X	Bradley & Gordon 1988	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	$F^{14}C$	cal BC/AD (95% confidence)		%C	%N	C:N	$\delta^{13}C$	$\delta^{15}N$	Source of date	Note
SK 1551	Whitehall Steps	Cranium (skull)	GrM-16837	1290 ±20	0.8518±0.0023	665	775	44.5	16.2	3.2	-20.29±0.05	10.34±0.10	Arthur	X
Burial 1*	Bull Wharf	Burial context (skeleton)	Beta-104819-20, 105483-4	X	X	680	810	X	X	X	X	X	Ayre & Wroe-Brown 2015	Radiocarbon date is weighted mean of four radiocarbon dates for wood from Burial 1. Burials 1 and 2 are considered by Ayre and Wroe-Brown (2008:160) to be almost certainly contemporaneous given their proximity to each other in such an unusual location.

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	F^{14}C	cal BC/AD (95% confidence)		%C	%N	C:N	δ^{13}C	δ^{15}N	Source of date	Note
Burial 2*	Bull Wharf	Burial context (skeleton)	X	X	X	X	X	X	X	X	X	X	Ayre & Wroe-Brown 2015	Radiocarbon date is weighted mean of four radiocarbon dates for wood from Burial 1. Burials 1 and 2 are considered by Ayre and Wroe-Brown (2008:160) to be almost certainly contemporaneous given their proximity to each other in such an unusual location.
GEN01 31	Kew	Cranium	OxA-14729	1070 ±29	X	890	1030	X	X	3.3	-19.00	10.90	Edwards et al., 2009	X
SK 139	Millbank	Cranium (partial skeleton)	GrM-16842	1114 ±19	0.8705±0.0020	890	995	43.9	16.0	3.2	-19.58	8.78	Arthur	X
E 213	Hampton	Calvarium	GrM-16892	912±19	0.8927±0.0022	1040	1210	44.2	15.9	3.2	-20.09	12.45	Arthur	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	$F^{14}C$	cal BC/AD (95% confidence)		%C	%N	C:N	$\delta^{13}C$	$\delta^{15}N$	Source of date	Note
BATT301	Battersea Power Station	Cranium	SUERC-52875	873±28	X	1040	1260	X	X	3.3	-19.10	12.90	Unpublished. Dated by SSE electric. Remains and radiocarbon report curated at MOL.	X
GEN0143	Barn Elms	Cranium	OxA-14727	768±27	X	1220	1280	X	X	3.2	-18.90	12.30	Edwards et al., 2009	X
SK 4179	Waterloo Bridge	Mandible	GrM-16847	402±19	0.9512±0.0023	1440	1615	43.9	15.9	3.2	-18.99	12.69	Arthur	X
SK 4119	Pimlico	Cranium	GrM-16897	277±18	0.9661±0.0021	1520	1665	44.5	16.0	3.2	-20.14	10.75	Arthur	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	$F^{14}C$	cal BC/AD (95% confidence)		%C	%N	C:N	$\delta^{13}C$	$\delta^{15}N$	Source of date	Note
Chambers 2*	Chambers Wharf	Scapula (partial skeleton)	OxA-11141–2	418±23	X	1640	1955	X	X	X	-16.90	12.50	Bayliss et al., 2004	Calibrated date is that given in (Bayliss et al., 2004), 95% probability, based on weighted mean of two dates. Calibration of the radiocarbon date for this individual is complicated by the fact that their diet had a large marine protein component (see Bayliss et al., 2004).
SK 4178	Greenwich	Cranium (partial skeleton)	GrM-16908	249±19	0.9695±0.0023	1530	1800	44.4	15.8	3.3	-19.71	10.91	Arthur	X
SK 1523	Somerset House	Cranium	GrM-16836	247±19	0.9697±0.0023	1530	1800	44.3	16.1	3.2	-18.97	12.47	Arthur	X
SK 1524	Tower	Calotte	GrM-16844	235±20	0.9713±0.0025	1635	1800	42.8	15.7	3.2	-19.27	12.37	Arthur	X

SK ID	Location	Element dated (associated elements)	Lab code	^{14}C AGE (yr BP)	$F^{14}C$	cal BC/AD (95% confidence)		%C	%N	C:N	$\delta^{13}C$	$\delta^{15}N$	Source of date	Note
SK 1549	Poplar	Cranium	GrM-16845	242±19	0.9704±0.0023	1635	1800	43.9	16.0	3.2	-18.08	13.11	Arthur	X
SK 1563A	Blackwall Tunnel	Mandible	GrM-16896	151±18	0.9814±0.0022	1665	1910	43.6	15.7	3.2	-19.21	11.35	Arthur	X
Burrells 1*	Burrells Wharf	Cranium (skeleton)	OxA-21181-2	193±26	X	1650	1920	X	X	X	X	X	Cohen et al., 2013	14C age and error values are those given in Cohen et al., 2013 and have been recalibrated and given to 95% confidence here.

Appendix B The genetic sex dataset

Appendix Table B.1: The genetic sex data produced externally to this thesis for individuals in the River Thames and Maynard Reservoir assemblages, alongside their corresponding osteological sex determination. “Osteo’ sex” refers to the osteological sex determination made by the author in this thesis (see Section 4.4.3.1). 1= Male, 2= Probable male, 3= Indeterminate, 4= Probable female, 5= Female. “Source (genetic sex)” refers to the project through which the genetic sex data were generated.

SK ID	Genetic sex	Osteo’ sex	Source (genetic sex)
SK 19	Male	2	Green et al., 2019
SK 4162	Female	3	Green et al., 2019
SK 1515	Male	3	Green et al., 2019
UNREG 1414	Male	2	Green et al., 2019
SK 1507	Male	1	Green et al., 2019
SK 1521	Male	1	Green et al., 2019
SK 1522	Male	2	Green et al., 2019
SK 3311	Female	3	Green et al., 2019
SK 4062	Female	4	Green et al., 2019
SK 4067	Male	1	Green et al., 2019
SK 4070	Male	1	Green et al., 2019
SK 4073	Male	2	Green et al., 2019
SK 4167	Female	4	Green et al., 2019
GEN01 52	Female	2	Booth, 2019
GEN01 27	Male	2	Booth, 2019
GEN01 29	Female	4	Booth, 2019
SK 1506	Male	2	Green et al., 2019
SK 1514	Male	2	Green et al., 2019
SK 1558	Male	2	Green et al., 2019
SK 4074	Male	3	Green et al., 2019
GEN01 51	Male	1	Booth, 2019
SK 1518	Male	5	Green et al., 2019
SK 4120	Male	2	Green et al., 2019
SK 4130	Female	2	Green et al., 2019
SK 4137	Male	1	Green et al., 2019
SK 139	Male	1	Green et al., 2019
E 213	Male	2	Green et al., 2019
SK 1551	Male	1	Green et al., 2019
SK 1523	Female	3	Green et al., 2019
SK 1549	Male	2	Green et al., 2019
SK 4178	Male	1	Green et al., 2019
SK 1563	Female	4	Green et al., 2019

Appendix C **The isotopic dataset**

Appendix Table C.1: The full isotopic data for individuals in the River Thames and Maynard Reservoir assemblages. "Lab ID" is the unique sample identifier provided by SUERC.

SK ID	Lab ID	Element sampled	Collagen yield (%)	$\delta^{15}N$‰	$\delta^{13}C$‰	$\delta^{34}S$‰	%N	%C	%S	CNMolar	CSMolar	NSMolar
SK 1515	GUsi7822	Cranium	7.8	10.3	-20.9	-6.0	15.6	43.7	0.22	3.3	541	166
SK 19	GUsi7816 A+B	Calvarium	6.6	10.6	-21.0	3.4	14.9	42.9	0.4	3.4	270	81
SK 4162	GUsi7815	Calvarium	5.2	10.9	-22.3	-11.3	15.5	44.6	0.36	3.4	329	98
SK 4167	GUsi7809	Calvarium	7.2	10.8	-21.0	-10.8	14.8	42.6	0.29	3.4	397	118
SK 1521	GUsi7823	Cranium	12.3	11.2	-20.9	-2.3	15.7	43.5	0.21	3.2	550	170
SK 1522	GUsi7806	Cranium	6.0	10.1	-20.6	-7.4	15.5	43.8	0.22	3.3	524	159
SK 4105	GUsi7789	Mandible	7.9	11.0	-20.5	-7.3	15.9	45.5	0.29	3.3	415	124
SK 4191	GUsi7817	Cranium	13.1	10.8	-20.8	-4.0	15.8	43.7	0.23	3.2	505	157
SK 4062	GUsi7801	Cranium	13.7	10.5	-21.1	5.0	15.4	44.1	0.21	3.4	563	168
UNREG 1414	GUsi7810	Cranium	13.5	10.7	-20.9	-0.5	15.7	43.3	0.20	3.2	566	176
SK 4067	GUsi7787 A+B	Cranium	11.5	11.1	-20.1	-14.5	15.5	44.1	0.22	3.4	533	160
SK 4070	GUsi7819	Calvarium	12.2	11.5	-20.0	-2.6	15.6	43.6	0.25	3.3	474	145
SK 3311	GUsi7826	Cranium	9.6	11.5	-20.5	-12.8	15.3	42.1	0.21	3.2	545	170
SK 1507	GUsi7802 A+B	Cranium	11.1	10.3	-19.7	4.1	15.6	44.5	0.24	3.4	489	147
SK 4084	GUsi7803	Calotte	9.3	12.4	-20.4	-6.1	15.8	45.2	0.29	3.3	416	125
SK 4073	GUsi7805	Calvarium	11.6	11.3	-20.0	0.6	15.7	44.6	0.26	3.3	463	140
SK 1520	GUsi7827	Cranium	3.8	10.7	-20.5	5.2	15.8	43.2	0.21	3.2	542	170
SK 1529	GUsi7825	Cranium	6.4	11.6	-20.5	0.8	15.4	43.5	0.26	3.3	443	135
SK 1516	GUsi7807	Cranium	4.7	11.5	-20.3	-6.5	15.5	43.8	0.25	3.3	477	144

SK ID	Lab ID	Element sampled	Collagen yield (%)	$\delta^{15}N$‰	$\delta^{13}C$‰	$\delta^{34}S$‰	%N	%C	%S	CNMolar	CSMolar	NSMolar
SK 4069	GUsi7818	Cranium	13.3	9.4	-20.6	-3.7	15.7	44.0	0.28	3.3	425	130
SK 1506	GUsi7804	Calvarium	4.0	11.7	-20.4	-9.9	15.6	44.6	0.25	3.3	476	142
SK 4092	GUsi7788	Mandible	10.5	11.8	-20.8	-7.2	16.0	44.8	0.24	3.3	496	152
SK 1514	GUsi7790	Cranium	5.0	10.7	-20.5	-4.8	17.2	49.0	0.22	3.3	593	178
SK 4074	GUsi7820 A+B	Calvarium	10.5	10.5	-20.6	-5.4	15.7	44.4	0.28	3.3	429	130
SK 4055	GUsi7786	Cranium	11.4	12.6	-20.9	-16.2	15.8	44.4	0.25	3.3	470	144
SK 1526	GUsi7799	Mandible	12.8	12.3	-19.8	16.3	15.8	44.4	0.27	3.3	433	132
SK 1558	GUsi7792	Cranium	5.5	12.0	-20.0	7.7	15.9	45.0	0.23	3.3	533	162
SK 4120	GUsi7821	Calvarium	12.8	11.2	-20.4	6.7	15.6	43.6	0.23	3.3	512	158
SK 4130	GUsi7795	Cranium	12.0	11.8	-18.8	4.0	15.9	45.0	0.24	3.3	493	150
SK 1518	GUsi7808 A+B	Cranium	8.3	9.4	-19.8	14.2	15.7	44.5	0.21	3.3	561	170
SK 4137	GUsi7813 A+B	Calvarium	5.2	13.4	-19.2	6.1	15.6	44.1	0.24	3.3	494	150
UNREG 6828	GUsi7824	Cranium	12.7	11.9	-20.0	5.6	15.9	43.9	0.22	3.2	539	167
SK 1551	GUsi7791	Cranium	7.0	9.0	-20.0	-1.9	14.5	40.3	0.23	3.2	476	147
SK 139	GUsi7811	Cranium	5.6	9.1	-19.7	11.3	15.4	43.8	0.21	3.3	566	171
E 213	GUsi7814	Calvarium	11.6	13.0	-20.2	-3.9	15.6	44.0	0.21	3.3	551	167
SK 4179	GUsi7793 A+B	Mandible	13.8	13.2	-19.0	4.0	16.0	45.0	0.22	3.3	559	170
SK 4119	GUsi7800	Cranium	13.1	11.2	-20.2	7.1	15.6	44.8	0.22	3.4	548	163
SK 4178	GUsi7796 A+B	Cranium	12.4	11.4	-19.8	6.1	15.4	43.7	0.26	3.3	452	137
SK 1523	GUsi7794	Cranium	6.2	13.0	-19.1	5.6	15.7	44.9	0.26	3.3	467	140
SK 1524	GUsi7812	Calotte	6.0	13.0	-19.3	3.9	15.5	44.3	0.27	3.3	439	132
SK 1549	GUsi7797	Cranium	4.4	13.7	-18.2	11.7	15.5	44.0	0.22	3.3	542	163
SK 1563A	GUsi7798	Mandible	7.6	12.0	-19.3	6.7	15.8	44.7	0.23	3.3	514	156